CURRICULUM VITAE
(July 22, 2016)

Professor Thomas Ming Swi Chang, O.C., M.D., C.M., Ph.D., FRCPC, FRS[C]
Director, Artificial Cells & Organs Research Centre
Departments of Physiology, Medicine & Biomedical Engineering
Faculty of Medicine, McGill University, Montreal, Quebec, Canada

Honorary Professor, Peking Union Medical College, Chinese Academy of Medical Sciences, China
Honorary Professor, Blood Transfusion Institute, Chinese Academy Medical Sciences, China
Honorary Professor, Nankai University, China
Honorary Professor, Shantou University Medical College

Honorary President, Artificial Cells, Blood Substitutes & Biotechnology (an international network)
Honorary President, International Society of Nanomedical Sciences

Editor in Chief, Artificial Cells, Nanomedicine & Biotechnology, an international Journal,
Infoma Press to Taylors and Francis UK
Editor in Chief, Regenerative Medicine, Artificial Cells & Nanomedicine, Book Series,
World Publisher/Imperial College Press,

Mailing address:
Department of Physiology, Faculty of Medicine, McGill University
3655 Promenade Sir-William-Osler, Room 1004
Montreal, Quebec, Canada H3G 1Y6
e-mail: artcell.med@mcgill.ca
Website: www.artcell.mcgill.ca

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ONE PAGE EXECUTIVE SUMMARY

Professor Thomas Ming Swi Chang , O.C.,M.D.,C.M.,Ph.D.,FRCP(C), FRS(C)

Chang has been called the "**Father of Artificial Cells**". While an honours B.Sc. student at McGill Jniversity, he invented and prepared the first artificial cell (Chang, Hon B.Sc. research report, 1957). He continued his research in medical school then Ph.D. (Chang **Science** 1964, **Nature** 1971, **monograph** 1972). He now has nore than 546 full papers and 29 books. He has since developed artificial cell into a very large area around the vorld. A few examples are as follows.

Nanomedicine: is one of the many areas that came from his invention of artificial cells (Artificial Cells: he beginning of Nanomedicince http://www.worldscientific.com/doi/suppl/10.1142/8776/suppl_file/8776_chap01.pdf). He was the first to use nanotechnology and nanobiotechnology to prepare artificial cells containing biologically active material with 100-200 nanometer membrane thickness polymers, crosslinked proteins or other membranes. He was also the first to prepare soluble nanobiotechnological complexes. Nanomedicine is now a large area and extensively developed around the vorld. His peers name him honorary president of the Int Soc Nanomedical Sciences.

Hemoperfusion: While waiting for world interest in biotechnology, Chang first used nanotechnology of ultrathin polymeric membrane artificial cells containing adsorbents for hemoperfusion. His clinical trials in patients esulted in FDA approval. This has since been used routinely in patients for acute poisoning and detoxification around he world especially where the cost is reasonable. http://www.medicine.mcgill.ca/artcell/512.pdf Extensions have resulted in mmunosorbent hemoperfusion for immunological diseases like Lupus etc.

Blood substitutes: HIV contaminated blood in the 1980s led many groups to develop his basic research on nanobiotechnology based polyhemoglobin as blood substitutes. This has been developed by 2 groups and tested clinically in the U.S. and is now approved for routine use in South Africa and Russia. His group is now working on a nore complete 3rd generation system with enhancement of all 3 functions of red blood cells. In animal study in a 90 nin sustained severe hemorrhagic shock model this is superior to whole blood. ttp://informahealthcare.com/doi/pdf/10.3109/21691401.2014.964554 This research is now being supported by the Canada Blood Service/CIHR. Peer recognition has resulted in his being appointed the Honorary Symposium President of the biannual International Symposia on Blood Substitutes including the most recent ones: 2011 XIII Harvard, Boston, 2013 XIV Blood Transfusion Institute, China and XV Lund Sweden 2015 XV.

Drug Delivery systems: Many groups have also extended his idea of artificial cells for use in nanomedicine based drug delivery systems and they call these artificial cells as microcapsules, microparticles, nanocapsules, nanoparticles, liposomes, polymersomes etc. Artificial cells can now be prepared in the micro, nano or soluble nanodimension complexes.

Bioencapsulation of cells/stem cells/genetic engineered cells followed his original research on cell encapsulation. This is being investigated around the world for potential clinical uses in liver failure, kidney failure, genetic diseases etc http://www.medicine.mcgill.ca/artcell/510.pdf http://www.medicine.mcgill.ca/artcell/511.pdf

Other areas: Advances in molecular biology, biotechnology, nanotechnology and other areas have led to rapid developments in the use of his invention of artificial cells for nanomedicine, bioencapsulation, gene therapy, enzyme therapy, cell/stem cell therapy, regenerative medicine, blood substitutes, liver/kidney support systems and even in agriculture, aquatic culture, fermentation industry, food industry, nanorobotics, nanocomputers and other areas. More details are summarized in http://www.medicine.mcgill.ca/artcell/2005NatureRev.pdf .

Appointments & honours: Medical Research Council of Canada (MRC) awarded him "scholar (junior career)" (1965-68), then the MRC career investigator award (1968- until after 65 age limit 1999). At McGill, He rose from assistant professor (1966) to associate professor (1969) to full professor (1972). In 2007 he asked to be appointed emeritus professor to allow him to have more flexibility in international activities ttp://www.medicine.mcgill.ca/artcell/CentreChart.pdf. He continues to be the Director (since 1979) of McGill's Artificial Cells & Organs Research Centre, an international centre. His other international activities include for examples: Honorary Professor, Peking Union Medical College of the Chinese Academy of Medical Sciences (CAMS), Honorary Professor, Blood Transfusion Institute (CAMS), Honorary Professor, Nankai University, Honorary Professor. Shantou University Medical College. Honorary President, International Society (network) Artificial Cells, Blood Substitutes & Biotechnology; Editor in Chief, Artificial Cells, Nanomedicine & Biotechnology, Honorary President, International Society Nanomedical Sciences; Editor in Chief, Regenerative Medicine, Artificial Cells & Nanomedicine, book series

Awards: His awards start with the 1969 "Inaugurate First Incentive Lecturership" given in Sweden at Karolinska Institute, Lund Univ and Gothenburg Univ Hospital, then others including Clemson Award, Silver Medal Award of Bologna Univ, First Julius Silver Lectureship of Technion, Confederation Medal Award, Queen Elizabeth 25th Jubilee Medal, ISBP Annual Award, Virage Award, ISBS life time achievement award, first "Outstanding Research Award" of the Int Academy of Nanomedicine, Q.E. Diamond Jubilee Medal,. He also received the highest Canadian civilian decoration of Order of Canada. He has been nominated for Nobel Prize in Medicine and Physiology and for Nobel Prize in Chemistry. In 2011 he was voted the Greatest McGillian out of 700 nominee in McGill's 190 years history http://www.medicine.mcgill.ca/artcell/voting%20result.pdf .Other details on his public service website: http://www.medicine.mcgill.ca/artcell

Comments by his peers

Greatest McGillian in the university's 190 years history *A 2011 world wide poll voted the inventor of artificial cells, Chang, as the "Greatest McGillian" out of 20 finalists from 700 nominee in McGill University's 190 years history. http://www.medicine.mcgill.ca/artcell/votingresult.pdf*

The Canadian Academy of Health Sciences "Dr. Chang's original ideas were years ahead of the modern era of nanotechnology, regenerative medicine, gene therapy, stem cell/cell therapy and blood substitutes. Evidence of his stature within the international scientific community was confirmed by 2 nominations for the Nobel Prize".

United Kingdom journal, New Scientist: In 1957, Thomas Chang was completing his final year as an undergraduate at McGill University in Montreal. … He would make the first artificial cell..... has grown into a dynamic field....worldwide. …. artificial cells is now a sophisticated marriage of microbiology, chemistry and biotechnology, the concept remains as straightforward as Chang's original notion. Theoretically, an artificial cell can contain virtually anything: oxygen, drugs, enzymes, antibodies, cell extracts and even cells themselves.... can now create artificial cells with roughly 30 different polymers, as well as several kinds of proteins. .....in 1961(Bangham) also added lipids to the list …."liposomes"

Journal of the British Royal Society of Chemistry , "Chemistry in Britain": Professor Tom Chang ……when he started work in the 1950's he was ploughing a lone furrow. Chang is credited with inventing microencapsulation, ……. can emulate both in vitro and in vivo the behaviour of some natural cells. "Artificial cells" already have many medical applications..... chronic renal failure, drug poisoning, liver failure, enzyme therapy and metabolic function replacement. He told Chemistry in Britain: "When I first started work it was considered too far-fetched, but by 1966 when I demonstrated the value of artificial cells in hemoperfusion and detoxification there was a surge in interest and curiosity. … interest in artificial cells and especially modified hemoglobin as a blood substitute has taken off".

"American Medical News(American Medical Association)" (Mark Moran):
For nearly 40 years, Dr. Chang has pursued the development of artificial blood, and his work has laid the foundation for products that may be available in coming years. These products, however, are not true red blood cells but modified hemoglobin molecules for short-term transport of oxygen ..... Today, Dr. Chang is working on products that more closely resemble nature's own creation....."

"Blood Weekly",U.S.A.: "The conference (VI International Symposium on Blood Substitutes) coincides with the 40 year anniversary of Chang's initial efforts back when he was a student at McGill University. This started … the modern approach of red blood cell substitutes……. McGill University, where Chang and his colleagues have been instrumental in advancing the field of blood substitute research".

Modern Drug Discoveries, ACS Publications: "The first encapsulated cells were developed as far back as the 1960s, when T.M.S. Chang and colleagues first reported the ….. microencapsulation of cells. The vision of using these cells for therapeutic purposes was present from the start…….. Several polymeric encapsulation systems have been developed or are currently being tested in clinical trials…. Many …. are examining the use of biocompatible .. membranes to surround the encapsulated cells"

Nature Medicine, "Cell encapsulation: promise and progress" G. Orive et al
In 1964 Chang (Chang. **Science** 146(3643):524-525) proposed the idea of using ultrathin polymer membrane microcapsules for the immunoprotection of transplanted cells and introduced the term "Artificial Cells" to define the concept of bioencapsulation. Since then …bioencapsulation has provided a range of promising therapeutic treatments for diabetes, hemophilia, cancer and renal failure".

From 50th Anniversary Special Gold Edition of the Official Journal of The American Society for Artificial Internal Organs The 1966 paper by Chang is one of the 25 landmark papers selected for this Gold edition. The editorial comments "…Chang is the originator of artificial cells…for medical applications such as related to the artificial kidney, artificial liver, detoxification, enzyme therapy etc… in addition… he is also recognized for his work in the artificial blood field on hemoglobin type products. (Others included Kolff, inventor of artificial kidney; Scribner for chronic hemodialysis; Gibbon on heart-lung machine; Cooley first human implant of artificial heart; Kantrowitz on intra-aortic balloon pumping; Kolobow on oxygenator)

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ONE PAGE EXECUTIVE SUMMARY IN CHINESE

張明瑞教授 - **1933** 年出生於中國廣東省汕頭市. 在汕頭完成了小學和在香港 **D.B.S.** 完成了中學後，就進入了加拿大著名的麥基爾大學進修醫科. **1957** 年張明瑞教授仍然是加拿大滿地可市的麥吉爾大學生理學的本科生，他就成功地發明了世界上第一人造細胞』, 被譽為『人造細胞之父』『**人造細胞**』是微米系统和纳米系统的原始,他的發明引致了『人造細胞』在納米醫學、納米生物技術、基因治療、酶療法、細胞/**幹細胞治療、癌症治療、再生醫學、血液代用品、和肝臟支持系統上的應用。它甚至**產生了對農業，水產文化，發酵工業，食品工業，生物技術，納米機器技術等諸多領域發展的影響.
http://www.medicine.mcgill.ca/artcell

❖ 获颁发加拿大勋章 **O.C.**

❖ 2011 **被選為『麥基爾大學 190** 年历史中**最傑出人物**』
http://www.medicine.mcgill.ca/artcell/voting%20result.pdf

- **1957** 年，『人造細胞』的研製成功
- **1957** 年，學士學位 **(B. Sc.,** 麥吉爾大學**)**
- **1961** 年，醫學博士學位**(MD,CM,**麥吉爾大學 **)**
- **1965** 年，博士學位**(Ph.D,** 麥吉爾大學**)**

- 加拿大皇家醫學院院士 **FRCPC**
- 加拿大皇家學會院士 **FRSC**
- 創辦主任 - 麥吉爾大學人造細胞及器官研究中心
- 终身教授 - 麥吉爾大學醫學院生理学部
- 终身教授 - 麥吉爾大學醫學院医学部
- 终身教授 - 麥吉爾大學醫學院生物医学工程部
- 名譽教授 - 北京協和医学院
- 名譽教授 - 南開大學
- 名譽教授 - 中国医学科学院输血研究所
- 名譽教授 - 汕**头**大學医学院
- 名譽總裁 - 國際人造細胞, 血液代用品,生物技術學會
- 名譽總裁 - 國際**納**米醫學學會
- 主编 - 人造細胞, **納**米醫學,生物技術
- 出版 ： **29** 本書及 546 論文
- 講學 ： 應邀請在世界各地舉行了 **500** 多個講學。

以下是張明瑞教授部分的簡歷：
http://www.medicine.mcgill.ca/artcell/Ming%20Poa%20web.pdf
http://www.medicine.mcgill.ca/artcell/1SeptDays.pdf

ARTIFICIAL CELL: Brief summary on what is it and what can it do?

While a B.Sc. student at McGill University, Chang was able to prepare the first artificial red blood cells with ultrathin artificial cell membranes that do not have blood groups (Chang 1957 honors B.Sc. Research Report, http://www.medicine.mcgill.ca/artcell/514.pdf) Figure on left from Chang, **Science** 1964 published in B/W showing artificial red blood cells with all the hemoglobin and complex enzyme system of red blood cells figure on right)

Beside artificial red blood cells, he has extended his earlier research into many forms and uses for artificial cells (Chang, **Science**, 1964, Chang & Poznansky, **Nature,** 1968; Chang, **Nature**, 1971 and Chang, **1972 Monograph on Artificial Cells** 1972). This initial research on artificial cell forms the basic principle that has been extended for development into possible uses in many areas by his group and many groups around the world (TABLE I). This includes Enzyme/gene therapy; cancer therapy; treatment of poisoning; cell/stem cell therapy for diabetes, acute liver failure etc; nano diagnostics; food industry; agriculture; nanocomputers, nanorobotics, etc. This principle is playing an important role in the modern era of nanomedicine, nanobiotechnology and regenerative medicine (Chang 2005 **Nat.Rev.Drug Disc**. http://www.medicine.mcgill.ca/artcell/2005NatureRev.pdf ; Chang 2007 **Monograph on Artificial Cells** http://www.medicine.mcgill.ca/artcell/2007%20ebook%20artcell%20web.pdf ; Chang 2015 **webite** www.artcell.mcgill.ca).

TABLE I: ARTIFICIAL CELL: applications

Chang (2005) Nature Review: Drug Discovery
Chang (2007) Artificial Cell Monograph
Chang (2009) www.artcell.mcgill.ca

- Hemoperfusion
- Drug delivery
- Blood Substitutes
- Enzyme & gene therapy
- Cell & Stem Cell Therapy
- Biotechnology & Nanobiotechnology
- Nanomedicine
- Regenerative medicine
- Agriculture, Industry, Aquatic culture
- Nanocomputers and nanorobatics
- Nanosensors etc

The next figure gives the basic principle of artificial cells and also examples of some of the possible variations. Unlimited possible variation in the content, dimensions and membrane materials for artificial cells is the reason why many uses are possible.

Basic principle of early Artificial Cells
(Chang 1957,1964)

Types of early Artificial Cells
(Chang 1957 to 1966)

Present status of Artificial Cells
(Chang 2005 Nature Rev Drug Disc)

(1) Artificial cells can contain the same biological material as biological cells: including hemoglobin and all red blood cell enzymes, microsomes, cytosol, polymerases, ribosomes and transcription/translation system. In addition, they are more versatile since adsorbents, magnetic materials, drugs, cells, stem cells, enzymes, multienzyme systems, multi-compartment systems, hemoglobin, microorganism, vaccines, gene for gene therapy, genetically engineered cells, hormones, peptides, and many other materials can also be included separately or in combination.

(2) In addition to being of cellular dimensions in the micron range, they can also be in the macro range, in the nano range or in the soluble nanobiotechnological range

(3) Membrane of artificial cell separates its content from the outside, but at the same time the membrane can be prepared to selectively allow different types of molecules to cross,

Further readings: www.medicine.mcgill.ca/artcell a free public service website with complementary reviews, books, videos and other material on this subject

DEGREES:

1957 B.Sc. (Honours Physiology) McGill University ("invented" artificial cells while an undergraduate student on honours research project). .
1961 M.D., C.M. Faculty of Medicine, McGill University.
1965 Ph.D. (on artificial cells including blood substitutes), Departments of Chemistry & Physiology, McGill University.
1972 F.R.C.P.(C), Medical Sciences, Royal College of Physicians and Surgeons of Canada (based on examination of research and clinical trials on artificial cells).
2003 F.R.S.[C]. Fellow of the Royal Society of Canada

APPOINTMENTS

(1) RESEARCH APPOINTMENTS AT McGILL

1962-1965 Medical Research Council of Canada Research Fellow, Department of Chemistry then Department of Physiology
1965-1968 Medical Research Council of Canada Scholar (career development award),
1968- 1999 Medical Research Council of Canada Career Investigator, (laboratory research and clinical trials). Until MRC's Career Investigator Program ended in Dec 1999.
1975-1978 Director, Artificial Organs Research Unit, Department of Physiology, McGill University
1978-1979 Director, Artificial Organs Research Unit, Faculty of Medicine, McGill University
1979- ongoing: Director, Artificial Cells and Organs Research Centre, McGill University.

(2) ACADEMIC APPOINTMENTS AT McGILL

Physiology

1965-1966 Lecturer of Physiology, McGill University
1966-1969 Assistant Professor of Physiology, McGill University
1969-1972 Associate Professor of Physiology, McGill University
1972-2007 Professor of Physiology (tenured since l975), McGill University
2007- ongoing In order to be more flexible in my research and international collaborative research and international scientific activities, I requested McGill to appoint me as Emeritus Professor of Physiology, McGill University

Medicine

1972-1975 Assistant Professor of Medicine and Clinical Medicine, McGill University and Royal Victoria Hospital (clinical trials)
1975-2007 Professor of Medicine (tenured), McGill University and Royal Victoria Hospital (clinical trials)
2007--ongoing In order to be more flexible in my research and international collaborative research and international scientific activities, I requested McGill to appoint me as Emeritus Professor of Medicine, McGill University

Biomedical Engineering (Department formed in 1990)

1990-2007 Professor of Biomedical Engineering (tenured)
2007- ongoing In order to be more flexible in my research and international collaborative research and international scientific activities, I requested McGill to appoint me as Emeritus Professor of Biomedical Engineering.

Chemical Engineering and Chemistry

1983-2002 Associate of Chemical Engineering, McGill University (Until Biomedical Engineering Department's Ph.D. program was approved. Before this, half of his Ph.D. students graduated from the Department of Chemical Engineering).
1985-2000 Associate of Chemistry, McGill University (Until Biomedical Engineering Department's Ph.D. program was approved)

(3) HONORARY ACADEMIC APPOINTMENTS OUTSIDE McGill University

1983- ongoing Honorary Professor, Nankai University, Tianjin, China
2007- ongoing Honorary Professor, Peking Union Medical College, Beijing, China
2011-ongoing Honorary Professor and key consultant on blood substitutes, Blood Transfusion Institute of the Chinese Academy of Medical Sciences,
2013- ongoing Honorary Professor, Shantou University Medical College

(4) VOLUNTRY SERVICE AT COMMUNITY MONTREAL CHINESE HOSPITAL:

1966-until Medicare well established and staff hired. Director of Medical Board and Director of Laboratory, until Medicare started
1968-1981 Consultant
1982-1987 Honorary Consultant
1987- ongoing Honorary Staff

EXAMPLES OF HONOURS AND AWARDS:

- Medical Research Council of Canada (MRC) Research Fellow Award 1962-65
- MRC Research Scholar Award (career development award) 1965-68
- Career Investigator Award , Medical Research Council of Canada 1968-1999
- First Incentive Lecturer. The Annual Incentive Lectures were instituted in Sweden in 1969. The first Incentive Lecturer was "invited to inaugurate these annual lectures". The lecture on "The Clinical Potential of Enzyme Technology" was given at: Karolinska Institute, Stockholm, University of Lund, University of Gothenberg Hospital (1969).
- Clemson Award for "Basic Research in the Development of the Microcapsule Artificial Kidney", World Congress of International Society for Biomaterials, Vienna, Austria. (1980)
- Honorary President IV International Symposium of Hemoperfusion and Artificial Organs, Ankara, Turkey (1982).
- Honorary President, VI International Symposium on Hemoperfusion, Mexico (1985).
- Honorary Professor, Nankai University, Tianjin, PRC. 1983-present
- Honorary President, VII International Symposium on Hemoperfusion, Kiev, USSR, sponsored by the USSR Academy of Sciences, (1986)
- Annual Award of the Education Foundation Federation of Chinese Canadian Professionals, Toronto. (for invention of "Artificial Cells including blood substitutes"), 1986
- “Ambassador by Appointment" and, AGORA Trophy, Societe du Palais des Congres de Montreal , 1986
- Honorary President, 8th International Symposium on Hemoperfusion, Sorbents and Immobilized Bioreactants, Germany, 1988.
- Silver Medal Award for outstanding scientific contribution from Academic Senate of University of Bologna for the 9th Centenary of University of Bologna, 1988
- Honorary President 9th International Symposium on Hemoperfusion, Sorbents and Immobilized Bioreactants, Tokyo, Japan. , 1989
- Honorary president 10th International Symposium on Hemoperfusion, Sorbents and Immobilized Bioreactants, Rome, Italy, 1990
- Congress President, VIII World Congress, International Society Artificial Organs, 1991
- **Honorary President, International Society for Artificial Cells, Blood Substitutes and Immobilization Biotechnology (since 1991)**. (formed by originally group on Hemoperfusion, Sorbent and Immobilized Bioreactants)
- **Officer of the Order of Canada, for the invention of artificial cells 1992**.
- First Julius Silver Lectureship, Julius Silver Institute of Biomedical Engineering and Israel Society for Biomedical Engineering, 1992.
- 125th Anniversary of Canadian Confederation Medal Award from Governor General of Canada, 1993
- Honorary Congress President, XI World Congress, International Society for Artificial Cells,

Blood Substitutes and Immobilization Biotechnology, (Congress president: Professor R.Langer of MIT who organized the congress) Boston, 1994

- **President, International Society for Artificial Organs, 1994-96**
- **Honorary member, International Society for Microencapsulation, since 1995**
- Queen Elizabeth 25th Jubilee Medal, Governor General of Canada, 2002
- Honorary Congress President XII World Congress, International Society for Artificial Cells, Blood Substitutes and Immobilization Biotechnology (Congress President, is the president of the Chinese Academy of Medical Sciences that organizes the congress) co-congress president is the President of the Chinese Red Cross Society, Beijing, 1997
- **1999 ISBP Annual Award, International Society for Blood Purification** (Sir Roy Calne was winner of 1998 Award, other previous winners are Robert Rosenberg from NIH, Charles Dinarello then at Tufts and Colton from MIT)
- **"VIRAGE" AWARD FOR CENTRE OF EXCELLENCE IN BIOTECHNOLOGY**, QuebecMinistry of Higher Education, Science and Technology (1985- permanent since 1990 with salaries for 4 professors for the centre now integrated into the faculty salary budget.
- MSSS-FRSQ Research d'equip on Blood Substitutes in Transfusion Medicine (Chang-principal investigator). (2002-2008)
- Honorary President, IX International Symposium on Blood Substitutes, Tokyo, Japan 2003
- **Fellow of the Royal Society of Canada, FRS(C) 2004**
- Honorary President, X International Symposium on Blood Substitutes, Rhone Island, Providence, U.S.A. 2005
- Nominated for Nobel Prize in Medicine & Physiology, and also for Nobel Prize in Chemistry
- Honorary member, International Golden Key Honour Society (2005-)
- Honorary President, 2007 XI International Sym on Blood Substitutes, Beijing, (President of Symposium, Professor Liu Qian, Vice Minister of Health of China, president of Beijing Union Medical College Hospital and Vice President, Chinese Academic of Medical Sciences)
- **Special Award "For his 50 years Outstanding Contribution on artificial cells and Blood Substitutes"** from Professor Liu Qian, Vice Minister of Health of China and President of the 2007 XI International Symposium on Blood Substitutes, Beijing, China
- Honorary President, 2009 XII International Symposium on Blood Substitutes, Parma, Italy
- **Founding President, International Academy of Nanomedicine** 2009-2010
- **First "Outstanding Research Award of the International Academy of Nanomedicine**", at the First World Congress of the International Academy of Nanomedicine.
- Honorary President, 2011 XIII International Symposium on Blood Substitutes, Harvard Medical School, Boston, U.S.A. Symposium president, Professor Warren Zapol, Emeritus Chief of Anesthesia and Critical Care Medicine, Mass General Hospital, Harvard Medical School. http://www.medicine.mcgill.ca/artcell/536.pdf
- **2011 Voted as the Greatest McGillian in McGill University's 190 years history**.(Out of 700 nominee and 20 finalists that included Rutherford, Penfield, Osler, James McGill, Cohen and others) http://www.medicine.mcgill.ca/artcell/voting%20result.pdf
- **Honorary President, International Academy of Nanomedicine, since 2012** then continue as honorary president when it was reorganized into the International Society for Nanomedical Sciences.
- **Honorary President, International Society for Nanomedical Sciences, since 2013**
- **Honorary President. 2013 XIV ISBS** International Symposium on Blood Substitutes, Institute of Blood Transfusion, Chinese Academy of Medical School, President will be vice president of the Chinese Academy of Medical Sciences.
- Queen Elizabeth Diamond Jubilee Medal 2013
- **Honorary President. 2015 XIV ISBS** International Symposium on Blood Substitutes, Lund, Sweden. President Professor Leif Bulow
- **Honorary President, 2015 IV ISNS World Congress on Nanomedicine**, Turkey.

EXPERIENCE IN RESEARCH, DEVELOPMENT & CLINICAL TRIALS:

- **Invention of artificial cells:** including microencapsulation of biologically active materials and blood substitute while a final year B.Sc. student at McGill University in 1956 – published this as a 1957 research report to McGill available at the McIntyre Medical Library. Parttime independent research on artificial cells during premedical and medical school. Starting winter of 1956 and continued to 1961 then full time starting in 1992 to present.

- **First paper in this area in Science, 1964** After medical school and internship, continued with this research in the Chemistry Department and Department of Physiology and obtained a Ph.D. in 1995. This resulted in the first demonstration of the detailed methodology, in vitro feasibility and in vivo feasibility of artificial cell. Published the first paper in the area of artificial cells including blood substitutes (Chang, Science, 1964).

- **Areas of major discoveries**: It is only in the last 15 years that many of his original ideas on artificial cells are being increasingly applied and extended by researchers around the world. This is because many of his original ideas were reported years before the modern era of nanotechnology, regenerative medicine, blood substitutes, biotechnology, gene therapy, stem cell therapy, cell therapy and other areas. The editor of Nature Review Drug Discovery worked out a time line for Chang's 2005 review on "therapeutic applications of polymeric artificial cells" www.artcell.mcgill.ca/2005NatureRev.pdf and shows that Chang has made 20 of the 23 major discoveries in related areas.

- **Nanomedicine and Nanobiotechnology:** Researchers in the academic world of nanomedicine considered his work as the forerunner of nanomedicine and nanobiotechnology and elected him to be the founding president of the International Academy of Nanomedicine (2009) including their first "Outstand Research" Award at their 2009 World Congress. In 2013, this has evolved into the International Society for Nanomedical Sciences that has elected him to honorary president. He is editor of a 2013 book on "Selected topics in Nanomedicine" with the opening chapter of "Artificial Cells: the beginning of Nanomedicine"

- **Hemoperfusion: invention, animal testing, clinical trials and successful transfer of technology** In 1966, he invented the use of artificial cells containing adsorbents for hemoperfusion – perfusion of patient's blood through a column of artificial cells. He personally carried out scaled up, animal testing and clinical trial in patients. He showed the safety and effectiveness for treating patients with poisoning, kidney failure and liver failure. Right from the beginning, he formed an international symposium series rotating around the world including Montreal, UK, China, Germany, Russia, Israel, Japan, Turkey and Mexico, to freely help and stimulate others to develop this. As a result hemoperfusion devices are produced in China, Russia, Italy, UK, U.S., Sweden, Japan and other countries around the world. This led to extensions and productions by centers and companies around the world. Despite offers from many major companies outside Canada, he chose to do this in Montreal with a small Canadian start up company. Since he held no stock or interest in this company he was able to test the products in animal and clinical trial in patients. His results led to F.D.A.'s approval for routine use. He assigned the inventor's income for this to support this research center. This product is more successful than those produced by larger industries (Smith Nephew, Gambro, etc) – as a result, it was bought over by the National Medical Care, New Jersey, U.S.A. (now a subsidiary of Grace Co.).
  In a recent visit to China, they have used this to save thousands of accidental poisoned patients. Furthermore researchers in China and Japan have extended this into hemoperfusion systems in routine clinical uses for the selective removal of endotoxin and also in immunological diseases like lupus erythematosis etc.

- **Blood Substitutes:** In the mid 1980's, worries regarding HIV in donor blood have resulted in extensive development and extensions around the world on blood substitutes. The most successful ones are based on nanotechnology based polymerized hemoglobin, an idea shown by Chang in his 1964 Science paper and also in a later 1971 paper on glutaraldehyde crosslinking. His nanobiotechnology based glutaraldehyde polymerized hemoglobin principle has been developed and produced by two companies in the U.S. One of

these has been approved for routine human use in the world in South Africa and Russia. Polyhemoglobin only carries oxygen, thus his team has developed a second generation nanobiotechnology based polyhemoglobin-superoxide dismutase-catalase (D'Agnillo & Chang, Nature Biotechnology, 1998, Powanda & Chang 2002, Chang, 2008, Gu and Chang, 2009, Chang 2009) This carries oxygen and also remove oxygen radicals. Even more recently, his team has developed a polyhemoglobin-superoxide dismutase-catalase-carbonic anhydrase (Bian, Rong and Chang 2011, Bian,Wei and Chang 2013). This has all 3 functions of red blood cells: carries oxygen and carbon dioxide and remove oxygen radicals on an enhanced level. Most recent result shows that this is superior to whole blood in severe hemorrhagic shock beyond the 60mins safety window. (Bian & Chang 2015)
http://informahealthcare.com/doi/pdf/10.3109/21691401.2014.964554

For many years, Chang has been coordinating the international effort in the area of blood substitutes as honorary president and editor in chief of the international network: International Society for Artificial Cells, Blood Substitutes & Immobilization Biotechnology and as chairmen, cochairmen and since 2003 honorary president of the biannual International Symposium Series on Blood Substitutes (ISBS). The XIII ISBS was held in Mass General Hospital, Harvard Medical School, with Professor Warren Zapol as president. http://www.medicine.mcgill.ca/artcell/536.pdf The XIV ISBS was held in the Blood Transfusion Institute of the Chinese Academy of Medical Sciences with the vice-president of the Academy as the symposium president. Professor Lief Bulow from Lund University in Sweden will organized the 2015 XV ISBS

- **Enzyme therapy:** His team shows that microencapsulated enzymes can be implanted into animals to treat hereditary enzyme defects, acatalesemia (Chang and Poznansky Nature 1968) and for lymphosarcoma using asparaginase (Chang, Nature 1972). The problem was the need for injection. This has now been solved by his basic research that there is a very extensive recycling of amino acids between the body and the intestine (Chang et al 1989). This way, he showed that microencapsulated enzyme given by mouth could remove unwanted amino acids (e.g. Phenylketonuria – PKU). He has encouraged Professor Charles Scriver to help in developing this for clinical use with an U.S. company that has modified this approach for clinical testing. Chang's group is also studying the use of tyrosinase artificial cells and nanobiotechnology based PolyHb-tyrosinase for lowering systemic tyrosine to inhibit the growth of melanoma in (BLYu & Chang, Melanoma Research J, 2004, Furstier & Chang, 2011, Yun & Chang, 2013, 2015 and ongoing)

- **Encapsulation of living cells including stem cells:** He was the first to prepare artificial cells containing living cells to protect the cells from the immunological rejection system of the body (Chang 1964 Science, 1965, Chang et al 1966, Chang 1972). Despite offer from an U.S. company, he chose to help a Canadian company (Conaught Laboratory, Toronto) where Sun then devoted his whole research career on cell encapsulation. With international interest in biotechnology, Chang's basic research is now being extensively investigated by many groups around the world for encapsulating islets(for diabetes) liver cells (for liver failure), genetically engineered cells (for many conditions) and other cells (Nature Medicine Cell encapsulation: promise and progress" G. Orive et al Nature Medicine 2003 9:104-107, Chang: Nature Review: Drug Discovery 2005). Chang's recent research includes artificial cells containing bone marrow stem cells. When implanted into 90% hepatectomized rats, this increases the recovery of the rats to 100% vs 11 to 33% in the control and in free bone marrow stem cells (Liu and Chang, 2007, 2009, 2011)

- **Oral administration of artificial cells containing microorganisms** Research by Chang with his then graduate student (Prakash & Chang, Nature Medicine 1996, Chang Nature Medicine 1997), showed that encapsulated E.coli DH5 cells can be given orally to kidney failure rats to lower their blood urea level and other uremic waste product. This avoids the need to inject genetically engineered materials in gene therapy. His group has shown the possibility to use artificial cells containing modified lactobacilli that are used in Yogurt (Chow, Liu, Prakash and Chang 2003). Professor Eli Friedman, a well known, nephrologist in New York, is working with a U.S. company in clinical trial to use this for chronic renal failure patients with promising results. Dr. Prakash, now a full professor of this centre, is developing this approach in his start up company in ongoing clinical trials for other clinical conditions.

- **Other areas including drug delivery, biotechnology, chemical engineering, aquatic culture agriculture, nanorobotics, food industry, cosmetic industry and other areas. :** His work on microencapsulation of

biological material has been extended by many research groups and pharmaceutical companies to produce drug delivery systems for drugs, peptides and other biotechnological products. His use of a biodegradation polymer, polylactic acid, for microencapsulation (Chang, Bioengineering, 1972) is now being extended and developed extensively as a drug delivery system as nanoparticles, polymersomes or nanocapsules. His basic study on artificial cells containing magnetic materials (1966) is being extensively in nanomedicine. Another extension of his work is the use of Bangham's lipid membrane to form lipid membrane artificial cells – liposome. This also has wide spread applications as other delivery system. Artificial cell is also being developed in other areas of biotechnology, chemical engineering, aquatic culture, nanorobotics and other areas.

- **Further information**: www.medicine.mcgill.ca/artcell

EXAMPLES OF PEER REVIEW GRANT SUPPORT OF HIS RESEARCH:

1965- ongoing The major continuing research support comes from the Medical Research Council of Canada that is now renamed Canadian Institutes of Health Research.. His 1999-2005 renewal was ranked first by the grant committee for 5 years for the full amount then again ranked first and renewed for another 5 years for the full amount (2005-2009). This was most recently renewed (2009- 2013 effective to 2015 April) again for the full amount requested. CIHR continues with the support of this research in the form of a Canada Blood Service/CIHR operating grant (2014-2017) (Principle Investigator: Chang).

1985- permanent: "Virage" Award of Centre of Excellence in Biotechnology from Quebec Ministry of Science and Education (Chang-principal investigator). Application ranked first among the large number of applicants in the opening round of this award in 1985. The 5-year review of the "Virage" Award in 1990 was successful and it became permanently integrated into the centre as salaries for 4 tenure-track professors for this centre – now integrated into the salary budget of the university (Chang - principal investigator)

2014-2017 Principle Investigator of a research award on a 3rd Generation Blood Substitutes from the Canada Blood Agency/Canadian Institutes of Health Research Joint Program

Examples of earlier grant support

1968 to 1999: He held Medical Research Council of Canada's prestigious "career investigator award" since 1968, 3 years after his Ph.D. This has been peer reviewed and renewed every 5 years for a total of 31 years to 66 years of age. It normally ends at age 65, but MRC continued this until the end of the MRC Career Investigator Program in December 1999.

1990-2004 Chang held the Bayer/Canadian Blood Service/HemaQuebec peer review research grant starting in 1996 (Principle Investigator TMS Chang) for research on his 3rd generation nanobiotechnology based blood substitute. This award is normally for 2 years, but the peer review committee has continued to support the renewal of this grant for a total of 8 years (1996-2004). Since 2004 Chang has included this project as part of the following larger new grant.

2002- 2008 Principle investigator, MSSS-FRSQ Research Group on Blood Substitutes in Transfusion Medicine. Maximal length is 6 years. The Quebec Ministry of Health (MSSS) has implemented the Federal Government's Krever Commission Recommendation to improve the safety of blood supply and to increase research and development in related area including the establishment of research groups. The peer review committee of MSSS jointly with the Quebec Medical Research Council (FRSQ) has selected our application as the first research group supported under this effort.

Other research contracts from government agency and industries

OTHER INTERESTS: besides medicine and science

- Continuing updating on most recent approaches in management, project control, organization, negotiation, interpersonal relationship, techniques in clear writing and speaking
- Continuing updating on new approaches in microcomputer especially word processing, database, website management, organization, project control, negotiation, graphics, clear writing, and other areas. Also in mobile communications.
- Classical music, tennis, badminton, table tennis, weight training, physical conditioning, martial arts, books on history and cultural developments and others.

EXAMPLES OF INTERNATIONAL ACTIVITIES

KEY OFFICIAL POSITIONS

- Honorary President, International Society for Artificial Cells, Blood Substitutes and Immobilization Biotechnology (1991- ongoing).
- Honorary President, International Society of Nanomedical Sciences (2012-ongoing)
- President (1994-1996), President-elect (1992-1994), Immediate-past president (1996-98) International Society for Artificial Organs.
- Honorary member, International Society for Microencapsulation, (1995-ongoing).
- Senior Member, Society of Biomedical Engineering, since 1989.
- Honorary presidents, Chairman and co-chairman of International Symposia on Hemoperfusion, Sorbent and Immobilized Bioreactants. I (Montreal), II(Italy), III(Israel), IV(Turkey), V(PR China), VI (Mexico), VII (USSR), VIII(Germany), IX (Japan), X (Italy),
- Congress President, 7th World Congress, International Society for Artificial Organs and 4th International Symposium on Blood Substitutes, Montreal, 1991.
- Honorary Congress President, XI Congress, International Society for Artificial Cells, Blood Substitutes and Immobilization Biotechnology, organized by MIT with Professor R. Langer as Congress President, Boston, 1994.
- Honorary Congress President, XII Congress, International Society for Artificial Cells, Blood Substitutes and Immobilization Biotechnology, Congress president: President of the Chinese Academy of Medical Sciences & Peking Union Medical College; Congress co-president: is President of the Chinese Red Cross Society, Beijing, 1997.
- Chairmen of III(87,Montreal), IV(91,Montreal), VI (96,Montreal) and Co-Chairman of V(93,San Diego, USA), VII(97,Toyko,). VIII (99, San Diego) International Symposia on Blood Substitutes.
- Honorary President, 2003 IX International Symposium on Blood Substitutes, Tokyo, Japan 2003
- Honorary President 2005 X International Symposium on Blood Substitutes, Brown University, Providence, U.S.A.
- Honorary President, 2007 XI International Symposium on Blood Substitutes, Beijing, China 2007 organized by the Chinese Academy of Medical Sciences and Union Medical College. The symposium chairman was Professor Liu Qin vice-president of the Chinese Academy of Medical Sciences and President of the Union medical College Hospital – now vice premier of Health of China.
- Honorary President, 2009 XII International Symposium on Blood Substitutes, Parma, Italy. Symposium president was Professor Mazarrilli of University of Parma, Parma, Italy.
- Honorary President, 2011 XIII International Symposium on Blood Substitutes, Harvard Medical School, Boston, U.S.A. The symposium chairman was Professor Zapol, Professor and Chief of Anesthesia and Critical Care Medicine, Mass General Hospital, Harvard Medical School. http://www.medicine.mcgill.ca/artcell/536.pdf
- Honorary President, 2012 III Congress of the International Academy of Nanomedicine, Ankara, Turkey
- Honorary President. 2013 XIV International Symposium on Blood Substitutes, Institute of Blood Transfusion, Chinese Academy of Medical School, President was the Director of the Institute.
- Honorary President. 2015 XV International Symposium on Blood Substitutes, President will be Professor Leif Bulow, University of Lund, Lund, Sweden
- Honorary President 2015 IV ISNS World Nanomedicine Congress, Turkey.
- Honorary President 2017 V ISNS World Nanomedicine Congress, Montreal
- Honorary President. 2015 XV International Symposium on Blood Substitutes, Montreal

EDITORIAL BOARDS:

- **Editor-in-Chief** (1989 - ongoing), Artificial Cells, Nanomedicine and Biotechnology, An International Journal, 2015 increased from 4 issues to 6 issues per year and 8 issues per year 2016 (in 1986 invited to take over and modernize and reorganize the oldest journal in the field originally "Biomaterials, Medical Devices and Artificial Organs", an International Journal. In order to keep updated with the rapid progress in this area it has evolves into Artificial Cells, Blood Substitutes and Biotechnology, An International Journal and then its present name starting in 2013) Informa Publisher now Tayor & Francis, UK.

- **Editor-in-chief** of a book series on "Regenerative Medicine, Artificial Cells and Nanomedicine", World Scientific Publisher/Imperial College Press (official publisher of Nobel Prize Award Lectures since1921)..
  (1) TMS Chang 2007 monograph "ARTIFICIAL CELLS: biotechnology, nanomedicine, regenerative medicine, blood substitutes, bioencapsulation, and cell/stem cell therapy" started this series. Now available for free access by all on his McGill University public service site: http://www.medicine.mcgill.ca/artcell/2007%20ebook%20artcell%20web.pdf
  (2) Second in this series is the 2011 book on Novel Therapies in Terminal Renal Failure edited by Professor Eli Friedman's group
  (3) Third in this series is the 2013 book on Selected Topics in Nanomedicine edited by Chang
  (4) Fourth in this series is on "Hemoperfusion" editor by Chang with 4 coeditors for 2015
  (5) Fifth in this series will be the 2nd edition of the monograph by Chang 2017 on "ARTIFICIAL CELLS: biotechnology, nanomedicine, regenerative medicine, blood substitutes, bioencapsulation, and cell/stem cell therapy"

- **Editorial Board**, Journal of Microencapsulation, London, UK.(1990-)
- **Editorial Board**, New Biotechnology
- **Editorial board**. International Journal on Theoretical and Applied Nanotechnology (IJTAN) of The International Academy of Science, Engineering and Technology (2012-)
- **Honorary Editor**. Journal of Hepato-renal and artificial detoxication(2003-)
- **Associate editor**, Nanomedicine Journal (2014-)
- **Editorial Board**, Journal Biotherapy (2014-)
- **Editorial Board** ,J Biotechnology Bioengineering (2014-)
- **Associated editor**, Nanomedicine Research J (2014-)

Previous editorial boards

- Section Editor on Detoxification, International Journal of Artificial Organs, Official Journal of European Society of Artificial Organs. Wichtig Editore Publisher. (1985-2005)
- Section Editor on New Technology then editorial board, TASAIO, Official Journal of the American Society of Artificial Internal Organs. Lippincott Press, U.S.A. (1991-2003)
- Associate Editor, Biotechnology Annual Rev, Elsevier Science, Netherlands.(1995-2011)
- Editorial Board, Journal of Cell Transplantation. Pergamon Press, USA (1999- 2004)

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1. Who's Who in Artificial Organs Research, International Society for Artificial Organs (1977).
2. Marquis Who's Who in the East (1977,1978)(1995, 1996 Silver aniversary 25th 2014
3. Marquis Who's Who in America (1978 - ongoing).
4. Marquis Who's Who in the World, (1984 - ongoing).
5. Canadian Who's Who (1983 - ongoing).
6. Marquis Who's Who in Frontier Science and Technology, (1984 - ongoing).
7. American Men and Women of Science (ongoing)
8. Marquis Who's Who in Science and Engineering (1992 - ongoing)
9. International Who's Who in Medicine (1995 - ongoing)
10. American Biographical Institute "Five Hundred Leaders of Influence" (1995)
11. Marquis Who's Who in Medicine and Healthcare (1996 - ongoing)
12. Top 100 Scientists, International Biographical Centre, U.K. (2005)

GRADUATE STUDENTS SUPERVISED by CHANG (as the sole supervisor):

Before 1985 (only one example given):

Ph.D. (Physiology): **Mark Poznanski** was Professor Chang's first Ph.D. graduate in Physiology. He has recently been honoured with the Order of Ontario and Order of Canada. He has been for a number of years the president of University of Western Ontario's "Robart Institute for Medical Research" and has built up the institute to "600+ people with an average of $600,000+ per investigator" (www.robarts.ca). He is a founding member and past chair of the Council for Health Research in Canada, a research advocacy group in Ottawa, and also chairs the Scientific Advisory Board of the Canadian Medical Discoveries Fund,and Director of the Ontario Genomics Institute, he also founded London Biotechnology Incubator Inc., in addition to being on many biotechnology-industry related boards. He is now president of his own consulting firm.

After 1985 (complete list):

1986 Ph.D. (Physiology): Peter Keipert , was Senior Director, Blood Substitutes, Alliance Pharmaceutical Co., Calif., USA until 2004; 2005-2013 V.P. of Research in Blood Substitutes, Sangart Co. San Diego). Now part owner of the renewed Sangart Co.

1986 M.Eng. (Chem.Eng.): Maurice Cattaneo (continued for Ph.D. with Chang)

1986 Ph.D. (Expt. Med.): Zhi Qing Shi, M.D. Vice President REMD Biotherapeutics Inc, CA,USA. Was Medical Director, Genzyme Co, US, and Research scientist at Amgen Biotechnology Co.in U.S.A. after Assistant Professor in Physiology, University of Toronto

1987 Ph.D. (Physiology): Louis Bourget (then dentistry at McGill, now a dental surgeon)
1987 Ph.D. (Physiology): Vivek Dixit (retired Professor and Director, Laboratory of Artificial Liver Support, Department of Medicine, University of California at LA
1987 M.Sc. (Physiology): Andrew Budning (completed McGill University M.D., physician)
1987 M.Eng. (Chem.Eng.): Flavio Garofalo (continued for Ph.D. with Chang)
1987 M.Eng. (Chem.Eng.): David Morley (completed Law at McGill University and Oxford)
1989 Ph.D. (Physiology): Soudabeh Aghazaman Kashani, M.D. (now in clinical medicine)
1990 Ph.D. (Chem.Eng.): Maurice Cattaneo, Consultant (Previously Director, Technology Development, Cambridge Scientific Inc. Cambridge, MA.Adjunct Professor, Northeastern University, Boston. (Previously Research Scientist, NRC, Biotechnology Research Institute, Montreal)
1990 Ph.D. (Chem.Eng.): Flavio Garofalo (Research Scientist, in the Biotechnology Co. Microlife Technics in Florida)
1990 Ph.D. (Ad Hoc) Kang Fu Gu retired Senior scientist of a Biotechnology Company in China (Was senior Scientist, U.S. Biotechnology before this he was Senior Research Scientist of IBEX Technology, a Montreal biotechnology company)
1991 Ph.D. (Physiology): Jing Ning, M.D. (She was Research Scientist at Hemosol Inc., Etobicoke, Ontario, a blood substitute company)
1991 M.Eng. (Chem.Eng.): Vaia Coromili (continued to Ph.D. with Chang)
1991 M.Eng. (Chem.Eng.): Maryam Mobed (continued to Ph.D. with Chang)
1991 M.Eng. (Chem.Eng.): Daniel Duguay (continued to Ph.D. in Ottawa)
1992 Ph.D. (Chem.Eng.): Khaled Alsugair (started as assistant Professor in Saudi Arabia)
1993 Ph.D. (Chem.Eng.): Ian Lloyd George Manager, Research & Development, Polychem Product Ltd., Montreal (awarded NSERC Research Fellowship at Bureau of Medical Device, Ottawa)
1994 Ph.D. (Physiology): Silvia Bruni, M.D. (returned to Italy in clinical practice)
1996 M.Eng (Chem.Eng.): Sarah Safos (continued her Ph.D. with Dr. Scriver on use of artificial cells in PKU mice)
1996 Ph.D. (Biomed.Eng.): Satya Prakash now a Full Professor of Biomedical Engineering, McGill (Came to me as International scholar in Biotechnology from India)
1996 M.Sc. (Biomed.Eng.): Elizabeth Quebec
1997 Ph.D. (Chem.Eng.): Maryam Mobed , was Endowed Chair in Bioengineering, Davidson College of Engineering, U.S. (previously Research scientist, Bioscience Products Division, Agilent Technologies, a California Biotech company.)
1997 Ph.D. (Physiology): Felice D'Agnillo Graduated on dean's honours list (was N.I.H. International Forgarty Fellow, Bethesda, USA) , Now Senior Staff Scientist at FDA-NIH
2000 Ph.D. (Chem Eng): Vaia Coromili - no communication after graduation
2002 M.Sc (Physiology): Douglas Powanda (FCAR Scholarship) Continuned to compete his Master of Management at Concordia University
2004 Ph.D. (Biomed.Eng) Binglan Yu graduated on Dean's honours list with Geddes Award for best graduate student in Biomedical Engineering. Research fellow with Professor Zapol, previously Chief of Anesthesiology, Mass General Hospital, Harvard Medical School, then instructor, proposed for assistant professor there..
2004 M.Sc. (Biomed Eng) Noami Wong (NSERC studentship). Then was a staff engineer, Merck Frosst Co. Montreal. Now home as house wife
2005-2007 M.Sc (Biomed Eng) Caroline Fustier (scholarship student from Paris, France) Now a research scientist in a French Company.
2006- 2007 M.Sc. (McGill Program on Biotechnology) Jessie Rong. Continued to Medical School at University of Montreal

2007- 2008 M.Sc. (McGill Program on Biotechnology) Wei He after graduation continued work in a research lab.

2008-2009 M.Sc (McGill Program on Biotechnology) Qianqian DU, completed her M.Sc.and continued as research assistant in this laboratory for 1 year

2010-2014 Ph.D. (Biomedical Engineering) Yuzhul BIAN. Came with M.Sc. from Tsinghua University, Beijing. Graduated in June 2014. Now staff in a company in Beijing, China.

2011- Feb 2015 Ph.D. (Experimental Medicine) Yun WANG came with M.Sc. from Peking Union Medical College of the Chinese Academy of Medical Sciences. With a China Scholarship Council Scholarship

2011-2012 Ph.D. Trainee (Physiology) came with China Scholarship Council Scholarship. Now Assistant Professor, Xian University, PRC

2014 M.Sc. (McGill Program on Biotechnology) Chen Guo

2015 M.Sc (McGill Program on Biotechnology) Shou Ma

2015 M.Sc (McGill Program on Biotechnology) Christoher Lee

2015- 2018 Ph.D. (Experimental Medicine) Chen Guo.

Postdoctoral Fellows and Visiting Scholars

Large number coming from around the world and returning to take up senior positions as full professors, director of units etc.

OTHER TEACHING AT McGILL:

Physiology 518a: Course coordinator: 25 hours (1972 - Ongoing)

Physiology 518a 8 hours of lectures and 6 hours seminar(1972-Ongoing)

Biomedical Engineering 399-501A 2.5 hours of lectures (onging)

Biomedical Engineering (Prof Prakash's new course) 2 hours of lectures (ongoing)

Med 1 Physiology 5 hours of lectures (before 1972 to 2008)

Biotechnology 202-505B 3 hours of lectures

518a "Artificial Cells and Biotechnology" For many years, Professor Chang has organized this course and gives about half the lectures for this course. This is a difficult and highly demanding interdisciplinary advance course. This is included in the suggested courses for Physiology, Biomedical Engineering, Biotechnology Diploma, Biotechnology minor and others students came from Experimental Medicine; and anatomy and molecular biology and occasionally from the faculty of engineering.

PUBLICATIONS AND INVITED LECTURESHIPS:

Summary: More than 546 papers (abstracts not included) and 29 books and symposium volumes. Invited to more than 300 international invited lectureships including opening plenary lectures, special lectureships, keynote lectures, plenary lectures. He has also assigned 30 patents and patent applications to McGill University,

PUBLICATIONS: (abstracts not included)

1. CHANG TMS (1957) "Hemoglobin Corpuscles" Report of a research project for Honours Physiology, Medical Library, McGill University. Also reprinted as part of "30 anniversary in Artificial Red Blood Cells Research" J. Biomaterials, Artificial Cells &Artificial Organs 16:1-9, 1988." and also in Chang's 2007 Monograph on 'Artificial Cells' http://www.medicine.mcgill.ca/artcell/514.pdf
2. CHANG TMS (1964) Semipermeable microcapsules. **Science** 146(3643):524-525.
3. CHANG TMS (1965) Semipermeable aqueous microcapsules. Ph.D.Thesis,McGill University, Montreal.
4. CHANG TMS, FC MACINTOSH, SG MASON (1966) Semipermeable aqueous microcapsules: I. Preparation and properties. Can J Physiol Pharmacol 44:115-128.
5. CHANG TMS (1966) Semipermeable aqueous microcapsules ("artificial cells"): with emphasis on experiments in an extracorporeal shunt system. Trans Am Soc Artif Intern Organs 12:13-19.
6. CHANG TMS, LJ JOHNSON, OJ RANSOME (1967) Semipermeable aqueous microcapsules: IV. Nonthrombogenic microcapsules with heparin-complexed membranes. Can J Physiol Pharmacol 45:705-715.
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8. CHANG TMS, POZNANSKY MJ (1968) Semipermeable microcapsules containing catalase for enzyme replacement in acatalsaemic mice. **Nature** 218(5138):242-45.
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14. CHANG TMS, N MALAVE (1970) The development and first clinical use of semipermeable microcapsules (artificial cells) as a compact artificial kidney. Trans Am Soc Artif Intern Organs 16:141-148.
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16. CHANG TMS, A GONDA, JH DIRKS, N MALAVE (1971) Clinical evaluation of chronic, intermittent, and short term hemoperfusions in patients with chronic renal failure using semipermeable microcapsules (artificial cells) formed from membrane-coated activated charcoal. Tans Am Soc Artif Intern Organs 17:246-252.
17. CHANG TMS (1971) The in vivo effects of semipermeable microcapsules containing L-asparaginase on 6C3HED lymphosarcoma. **Nature** 229(528):117-118.
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19. CHANG TMS (1972) In vitro and in vivo kinetics of enzymes immobilized by microencapsulation. **Biotechnol & Bioeng** 14:520-525 (Symp.Vol 3:395-399).
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Biotechnology & Bioengineering 14:15-18 (Symp. Vol 3:15-18).
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27. CHANG TMS (1973) Immobilization of enzymes, adsorbents, or both within semipermeable microcapsules (artificial cells) for clinical and experimental treatment of metabolite-related disorders**. "Enzyme Therapy for Congenital Diseases"** D BERGSMA, ed. Birth Defects: Original Article Series, Vol IX, No 2),Williams & Wilkins Co., Baltimore, MD, pp 66-76.
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28. **CHANG TMS (May 2007) Monograph** on "ARTIFICIAL CELLS: biotechnology, nanotechnology, blood substitutes, regenerative medicine, bioencapsulation, cell/stem cell therapy" World Scientific Publisher/Imperial College Press 435 pages.**(Since April 2010 has obtained copyright to place this book for noncommercial free online viewing or download on:**
http://www.medicine.mcgill.ca/artcell/2007%20ebook%20artcell%20web.pdf
Book reviewed by A Gerson Greenburg, MD, PhD, Professor Emeritus of Surgery, Brown University, U.S.A. "This volume is the most comprehensive review of the field of artificial cells and associated fields published to date. It refreshes the knowledge of the experts while informing the naive of the history and promise of the future. Written in a conversational style and very well illustrated for fact and emphasis, it is an easy and informative read. Presented in easily accessible form are the underlying theories and concepts of artificial cells, blood substitutes, nanomedicine, regenerative medicine and stem cell therapy in the context of specific clinical situations ranging from general to very specific diseases. Basic science observations support the tested or proposed clinical applications in an exact manner. This volume contains a near encyclopedia quantity of information, carefully and logically assembled and presented. Future developments in the field will depend on the essential information presented here. An essential read for anyone interested in this field, the vision and foresight of this senior scientist and leading statesman of the field makes the topic accessible and understandable."

29. CHANG, TMS (2013) editor, Book on "Selected Topics in Nanomedicine" World Scientific Publisher/Imperial College Press pp590

30. Chang, Endo, Nicolaev, Tani and Zheng (in the press for 2015) editors, Book on "Hemoperfusion and Plasma-perfusion" World Scientific Publisher/Imperial College Press

30. CHANG TMS (in preparation) 2nd edition of Monograph on "ARTIFICIAL CELLS: biotechnology, nanotechnology, blood substitutes, regenerative medicine, bioencapsulation, cell/stem cell therapy" World Scientific Publisher/Imperial College Press

INVITED LECTURES:

1963 Invited speaker, Red Cell Club, NIH, Bethesda, Maryland, USA.
1963 Invited lecturer, Dept. of Physiology, University of Pennsylvania, Philadelphia, USA.

1964 Invited lecturer, Gordon Research Conference on Medicinal Chemistry, New Hampshire, USA.
1964 Invited lecturer, Merck, Sharpe and Dohe, New Jersey, USA.
1964 Invited lecturer, Eli Lilly, Indianapolis, Indiana, USA.

1965 Invited lecturer, University of Montreal, Montreal, Quebec, Canada.
1965 Invited lecturer, New York Blood Center, New York, USA.
1965 Invited lecturer, Battelle Memorial Institute, Columbus, Ohio, USA.

1966 Invited lecturer, NCR, Dayton, Ohio, USA.

1967 Invited lecturer, Dept. of Artificial Organs, Cleveland Clinic, Cleveland, Ohio, USA.

1968 Invited lecturer, Microencapsulation Symposium, New Jersey, USA.
1968 Guest speaker, Association of Professional Engineers, Ottawa, Ontario, Canada.
1968 Guest speaker, Stamford Section, American Chemical Society, Stamford,Connecticut .
1968 Invited lecturer, New York Blood Center, New York, USA.

1969 First Incentive Lecturer, The Annual Incentive Lectures were instituted in Sweden in 1969 to invite once a year a foreign scientist to give an Incentive Lecture in Stockholm and other Swedish universities. The first Incentive Lecturer was "invited to inaugurate these annual lectures". The lecture on "The Clinical Potential of Enzyme Technology" was given at:
1) Karolinska Institute, Stockholm, Sweden.
2) Chemical Centre, University of Lund, Lund, Sweden.
3) University of Gothenberg Hospital, Gothenberg, Sweden.
1969 Invited lecturer, Dept. of Physiology, University of Toronto,Toronto, Ontario, Canada.
1969 Invited lecturer, Dept. of Pathology, Rhode Island Hospital, Rhode Island, USA.
1969 MRC Visiting Professor, Dept. of Biophysics, University of Western Ontario, London, Ontario, Canada.
1969 Invited lecturer, Dept. of Artificial Organs, University of Utah,Salt Lake City,Utah,
1969 Invited lecturer, Alza Co., Pala Alto, California, USA.

1970 Invited lecturer, Cardiovascular Research Institute, San Francisco, California, USA.
1970 Invited lecturer, Renal Unit, Sydney Hospital, Sydney, Australia.
1970 Invited lecturer, Dept. of Physiology, University of Sydney, Sydney, Australia.
1970 Invited lecturer, Renal Unit, Prince Henry Hospital, Sydney, Australia.
1970 Invited lecturer, Biomedical Symposium, Australian Academy of Science and Society of Engineers, Sydney, Australia.
1970 Invited lecturer, Microencapsulation Symposium, New Jersey, USA.

1971 Invited lecturer, Dept. of Chemical Engineering, University of Pennsylvania, Philadelphia, Pennsylvania, USA.
1971 Invited lecturer, Gordon Research Conference on Biomaterials, New Hampshire, USA.
1971 Enzyme Engineering Conference, New Hampshire, USA.

1) Invited lecturer.
2) Invited panel discussant on "Future of Enzyme Engineering".

1971 Invited lecturer, Life Science Seminar, Battelle Memorial Institute, Columbus, Ohio,

1972 Invited lecturer, National Foundation Symposium on Enzyme Replacement, Sarasota, Florida, USA.
1972 Invited lecturer, Chemical Engineering Dept., Princeton University, New Jersey, USA.
1972 Invited lecturer, Biomedical Engineering Symposium, MRC Bioengineering Unit, University of Strathclyde, Glasgow, Scotland.
1972 Invited lecturer, Renal Unit, Edinburgh Royal Infirmary, Edinburgh Medical School, Scotland.
1972 Invited guest speaker, Canadian Kidney Foundation Annual Meeting.
1972 Invited lecturer, NIH, General Medical Sciences, Bethesda, Maryland, USA.
1972 Invited lecturer, Microencapsulation Symposium, New Jersey, USA.

1973 Invited lecturer, First International Microencapsulation Symposium,Athens, Georgia.
1973 Chairman, session on "Biomedical Applications" and invited lecturer, International Conference on Insolubilized Enzymes, Milan, Italy.
1973 Invited lecturer, Gordon Research Conference on "Separation in Engineering", New Hampshire, USA.
1973 Co-chairman, session on "Future Applications of Enzyme Engineering", Enzyme Engineering Conference.
1973 Invited lecturer, Enzyme Engineering Conference, Engineering Foundation.
1973 Invited lecturer, International Nephrological course, Parma, Italy.
1973 Invited lecturer, Microencapsulation Symposium American Chemical Society Annual Meeting, Chicago
1973 Invited lecturer, Canadian High Polymer Forum of Membranes, St. John,Quebec.
1973 Annual guest speaker, Japanese Society for Artificial Organs, Sandai, Japan.
1973 Guest speaker, Japanese Society for Promotion of Renal Transplantation,Tokyo, Japan.
1973 Invited lecturer, Tokyo Science University, Tokyo, Japan.
1973 Guest discussant, Panel on "Microcapsule Hemoperfusion for Chronic and Renal Failure", Tokyo College of Medicine and Dentistry, Tokyo, Japan.

1974 Visiting professor, Medical Engineering Session, Faculty of Medicine, University of Minnesota, Minneapolis, Minnesota, USA.
1974 Invited lecturer, Dept. of Anatomy, University of Minnesota, Minneapolis, Minnesota.
1974 Invited lecturer, American Chemical Society Symposium on "Polymer Graft in Biochemistry", California, .
1974 Invited panelist on "Sorbent for Uremia", American Society for Artificial Internal Organs Annual Meeting, Chicago, Illinois, USA.
1974 Invited lecturer, Microencapsulation Workshop, New Jersey, USA.
1974 Invited participant and session chairman, Workshop on "Implications of Enzyme Engineering". Organized by International Federation of Institutes for Advanced Studies, Stockholm, Sweden.
1974 Invited lecturer, "Immobilization of Enzymes by Microencapsulation", Gordon Research Conference on "Lysozyme", New Hampshire, USA.
1974 Invited lecturer and session chairman, 2nd International Microencapsulation Symposium, London, UK.
1974 Invited lecturer, International Symposium on "Artificial Support Systems for Acute Hepatic Failure", King's College Hospital Medical School, London, UK.

1974 Invited lecturer, International Society of Nephrology sponsored symposium on "Uremic Toxins and New Devices for their Removal", Naples, Italy.
1974 Invited discussant, Biomedical Research in Narcotic Abuse Problems, organized by the Non Medical Use of Drugs Directorate, Health & Welfare Canada.

1975 Conference on "Sorbents in Uremia and Hepatic Failure", Sponsored by the International Society of Nephrology, NIH Chronic Uremia Program and the Clinical Dialysis and Transplant Forum.
Invited introductory lecturer on "Microencapsulation and Coating for Adsorbent".
Invited lecturer on "Microencapsulated Adsorbent for Acute Intoxication, Liver Failure and Uremia".
Chairman of the session on "Hemoperfusion".
Panel discussant of second day sessions.
1975 Invited speaker, Symposium of the International Pharmacological Congress, Helsinki, Finland.
1975 Invited speaker, New York Nephrology Society, New York, USA.
1975 Invited speaker, Downstate University of New York, School of Medicine, New York,
1975 Invited lecturer, "Microencapsulation Workshop", New Jersey, USA.
1975 Invited lecturer, NIH group on "Liver Failure Support", Clinical Center, NIH, Bethesda, Maryland, USA.
1975 Invited lecturer, Nephrology Dept., Children's Hospital, National Medical Center, Washington, D.C., USA.
1975 Invited speaker, symposium on "Immobilized Enzyme Applications", Chemical Institute of Canada, Toronto, Ontario, Canada.
1975 Invited lecturer, Gordon Conference on "Transport Phenomena in Synthetic and Biological Membranes", New Hampshire, USA.
1975 Poona International Workshop and Symposium on Enzyme Engineering, Poona, India.
Main speaker on "Microencapsulated Enzymes".
Main speaker on "Medical Applications of Immobilized Enzymes".
Panel discussant on "Technique and Novel Approaches".
Chairman of session on "Applications of Immobilized enzymes".
1975 Invited speaker, University of Poona, Poona, India.
1975 Invited participant, Second International Federation of Institutes of Advanced Studies Workshop, Poona, India.

1976 Chairman, session on "Biomedical Applications of Microencapsulation" and Invited speaker, 3rd International Symposium on Microencapsulation, Tokyo, Japan.
1976 Chairman, "Panel on Adsorbent Hemoperfusion for Uremia, Acute Intoxication and Liver Failure", Annual Meeting, American Society for Artificial Internal Organs, San Francisco, California, USA.
1976 Invited lecturer, symposium on "New Technologies of Blood Purification in Uremia", sponsored by NIH, International Society of Nephrology, Weisban, Germany.
1976 Chairman and invited lecturer, Session on "Adsorbents in Therapeutic Medicine", Strathclyde Bioengineering Seminar series on "Artificial Organs", Glasgow, Scotland.
1976 Consultant and participant, "Drug Delivery Systems Workshop", NIH, Bethesda, Maryland, USA.
1976 Invited lecturer, Gordon Research Conference on "Immobilized Enzymes", New Hampshire, USA.
1976 Invited speaker, "Lecture Series on Possibilities of Synthetic Biology", Dept. of Life Sciences (James F. Danielli) Worcester Polytechnic Institute, Worcester, Massachusetts,

USA.

1976 Co-chairman, Session 3 on "Artificial Organs", llth International Conference on Medical and Biological Engineering, Ottawa, Ontario, Canada.

1977 International Enzyme Engineering Conference, Germany. Chairman, session on "New Medical Applications in Immobilized Enzymes". Invited speaker, "New Approaches of Biodegradable Polymer Membranes, Microcapsules and Microencapsulation of Multistep Enzyme Systems."

1977 Organizer and program chairman, McGill Artificial Organs Research Unit International Symposium on "Some Novel Approaches in Artificial Kidney, Artificial Liver and Detoxification", McGill University, Montreal, Quebec, Canada.

1977 NIH International Conference on "Fulminant Hepatic Failure", Bethesda, Maryland, Chairman, session on "Hemoperfusion Through Sorbents".
Invited speaker on "Albumin Cellulose Nitrate Coated Charcoal Hemoperfusion in FHF".
Invited speaker on "Microencapsulation of Multienzyme Systems and Recycling of Cofactors".

1977 Guest speaker, "Biomedical Applications of Artificial Cells", Montreal Physiological Society, Montreal, Quebec, Canada.

1977 Chairman, panel workshop on "Some Problems Related to Adsorbent Therapy", Annual Meeting, American Society for Artificial Internal Organs, Montreal, Quebec, Canada.

1977 Invited speaker, "Biomedical Applications of Enzymes" Symposium on Enzymes, American Chemical Society, Amherst, Massachusetts, USA.

1977 Invited speaker on "The Future of Hemodialysis", Dialysis '77 Symposium, Leeds, UK.

1977 First International Society of Artificial Organs Meeting, Tokyo, Japan.
Chairman, session on "Sorbents in Artificial Kidney".
Invited panelist, "Hepatic Assist Devices".

1977 Invited speaker, "Artificial Cells", Dow Cordis Artificial Kidney Division, Concord, California, USA.

1977 Invited speaker on "Hemoperfusion", Canadian Conference on Clinical Engineering, Notre Dame Hospital, Montreal, Quebec, Canada.

1978 Visiting Professor by invitation of the Chinese Academy of Sciences, lectured at:
i. Biophysics Institute, Chinese Academy of Sciences, Peking (12 hrs lectures, plus seminars and demonstrations).
ii. Capital Hospital (previously Union Medical School), Peking.
iii. National Symposium, Lang Fang (12 hours of lectures, plus seminars & demonstrations).
iv. Suchiachung Medical School, Suchiachung.
v. Hongchow Medical School, Hongchow.
vi. Shanghai Medical Association, Shanghai.
vii. Canton Medical and Scientific group, Canton.

1978 International Symposium on "Hemoperfusion, Dialysate and Diafiltrate Purification", Tutzing, Munich, Germany.
Chairman, session on "Hemoperfusion".
Invited introductory lecturer on "Hemoperfusion".
Invited lecturer on "Hemoperfusion in Fulminant Hepatic Failure".
Invited lecturer on "Conversion of Urea and Ammonia into Amino Acid".

1978 Invited speaker in symposium on "Nondialytic Management of Uremia", sponsored by NIH, Downstate Medical Center and New York Society of Nephrology, New York, USA.

1978 Invited speaker on "Biodegradable Drug Carriers", Gordon Research Conference,

Plymouth, New Hampshire, USA.

1978 Invited speaker on "Immobilized Enzymes in Therapy", Conference on "Enzyme Economy", Chicago, Illinois, USA.

1978 Keynote speaker, Annual meeting of the Biomaterials Society, University of Toronto, Toronto, Ontario, Canada.

1978 Chairman, session on "Hemodialysis", International Congress of the International Society of Nephrology, Montreal, Quebec, Canada.

1979 International Symposium on Hemoperfusion: Kidney Support, Liver Support and Detoxification", Israel Institute of Technology, Technion, Israel.
Co-chairman of Symposium.
Invited speaker on "Present Status and Prospective of Artificial Cells in Hemoperfusion".
Chairman, session on "Hemoperfusion".

1979 Invited speaker on "Progress in Polymer Encapsulation of Enzymes, Biospecific Adsorbents and Drugs", American Japanese Chemical Societies joint symposium, Honolulu, Hawaii, USA.

1979 International Enzyme Engineering Conference, Enzyme Foundation, New Hampshire, USA.
Invited speaker on "Novel Urea Removal Systems".
Co-chairman of Workshop on "Biomedical and Analytical Application".

1979 Reporteur, Enzyme Therapy in Congenital Diseases Symposium, Hilton Head, North Carolina, USA.

1979 Symposium co-chairman and invited speaker, International Workshop on "Hemoperfusion", Haifa, Israel.

1979 Invited speaker on "Artificial Liver Support", International Workshop on "Artificial Organs", Sorrento, Italy.

1979 Invited speaker, Faculty of Medicine, University of Edmonton, Alberta, Canada.

1980 Gordon Research Conference, "Drug Carriers in Biology and Medicine", New Hampshire, USA.
Co-chairman of Conference.
Invited speaker on "Artificial Cells".
Chairman of session on "Artificial Cells".

1980 International Symposium on "Artificial Liver Support", Hannover, Germany.
Invited speaker on "Effects of Artificial Liver Support for Galactosamine Fulminant Hepatic Failure Rats".
Co-chairman, session on "Hemoperfusion".

1980 Invited speaker on "Encapsulated Enzymes and Adsorbent" in replacement therapy. International Symposium on "Therapy in Congenital Diseases", Swiss Academy of Medical Sciences, Interlaken, Switzerland.

1980 Annual Meeting, American Society for Artificial Internal Organs, New Orleans, Louisiana, USA.
Invited plenary speaker on "Artificial Blood Cells" in plenary symposium.
Chairman, panel conference on "Adsorbent Hemoperfusion in Blood Purification".
Co-chairman, sessions on "Artificial Liver".

1980 Recipient "Clemson Award" for "Basic Research in the Development of the Microcapsule Artificial Kidney", World Congress of International Society for Biomaterials, Vienna, Austria.

1980 Guest speaker, Mexico Society of Nephrology, Mexico on: Artificial Cells. Hemoperfusion in Chronic Renal Failure. Hemoperfusion in Acute Intoxication and Liver

Failure.

1981 International Symposium on "Hemoperfusion", Bologna, Italy.
Invited speaker on "Hemoperfusion in 1981".
Session chairman on "Hemoperfusion General".
Guest editor of symposium proceedings.

1981 International Symposium on Detoxification Approaches in Chronic Schizophrenia, Berlin, East Germany.
Invited speaker on "Endorphin and Middle Molecule Removal in Schizophrenia".
Co-chairman on "Detoxification Session".

1981 Invited speaker, "Artificial Cells", Science Association, National Research Council of Canada, Ottawa, Ontario, Canada.

1981 "Distinguished Honoured Guest", Preview Ceremony, International Center for Artificial Organs and Transplantation, Cleveland, Ohio, USA.

1981 Annual Meeting, American Society for Artificial Internal Organs, Anaheim, California.
Co-chairman, session on "Plasma Manipulation and Enzyme".
Program Committee.

1981 Invited plenary lecturer on "Blood Compatible Adsorbent Hemoperfusion in Extracorporeal Blood Treatment", 4th International Symposium on Affinity Chromatography and Related Techniques, Katholieke Universiteit, Nijmegen, The Netherlands. (Unable to attend just before meeting, paper presented as publication in book)

1981 Invited speaker on "Present Status of Microencapsulated Adsorbent", Symposium on "Adsorbent in Uremia", Congress of the International Society of Nephrology, Athens, Greece. (Paper read in absence by Dr. E. Espinosa)

1981 International Congress of the International Society for Artificial Organs, Paris.
Invited speaker on "Hemoperfusion" in opening plenary symposium on "Controversies and Issues in Artificial Organs".
Chairman, session on "Hemoperfusion".
Keyman of Hemoperfusion, program committee of International Society.

1981 Invited speaker, "Artificial Cells Encapsulated Enzymes" in International Symposium on "Therapy of Inborn Errors of Metabolism", London, UK.
(Paper read in absence by Dr. M. Poznansky)

1981 Invited plenary speaker for plenary lecture on "Biomedical Applications of Immobilized Biologically Active Materials", 6th Biannual International Enzyme Engineering Conference, Kashikojima, Japan.

1981 International Symposium of Chemical Engineering, Montreal, Quebec, Canada.
Invited speaker plenary lecturer on "The Present Status of Research in Artificial Cells".
Chairman, session on "Artificial Organs and Implants".

1981 Invited speaker, "Microcapsules" in "Colloquium on Microcapsules and Microcarriers in Biotechnology", Massachusetts Institute of Technology, Cambridge, Massachusetts, USA.

1981 Invited speaker on "Biotechnology Research on Artificial Cells", McGill Biotechnology Symposium.

1981 Invited speaker, Biotechnology Seminars, McGill University, Montreal.

1982 Chairman of Gordon Research Conference on "Drug Carriers in Biology and Medicine", New Hampshire, USA (also session chairman and invited speaker on Artificial Cells).

1982 IVth International Symposium of Hemoperfusion and Artificial Organs, Ankara, Turkey.

Honorary President of symposium.
Invited speaker on "Past, Present and Future Perspectives of Hemoperfusion".

1982 Invited speaker, Canadian Science Writing Association Meeting, Montreal.

1982 Invited speaker on "Artificial Cells with Emphasis on Hemoperfusion in Uremia, Liver Failure and Acute Intoxication", Environmental Health Directorate

1982 Seminar Series, Bureau of Medical Devices, Health and Welfare Canada, Ottawa, Ontario, Canada.

1982 Invited lecturer on "Artificial Cells", Pediatric Travel Club, Montreal Children's Hospital, Montreal, Quebec, Canada.

1982 Invited lecturer on "Hepatic Coma", Medical Grand Round, Royal Victoria Hospital, Montreal, Quebec, Canada.

1982 Invited lecturer on "Present Status of Research on Artificial Liver Support", St. Luc Hospital, Montreal, Quebec, Canada.

1982 Invited speaker on "Artificial Cells: Applications of the biotechnology of microencapsulation and immobilized enzymes and cells", Seminar Program, McGill Chemical Society, Montreal.

1983 President, organizer and invited speaker, Fifth International Symposium on "Microencapsulation, including Artificial Cells", Montreal, Canada.

1983 Chairman and invited speaker, Symposium on Hemoperfusion, Congress of the European Society for Artificial Organs.

1983 4th Congress, International Society for Artificial Organs, Kyota, Japan.
Chairman, special graphic symposium on hemoperfusion.
Invited speaker on "Artificial Liver".
Program committee, Keyman on Hemoperfusion.

1983 Invited speaker on "Artificial Cells", symposium on "Plastics and Artificial Organs", American Chemical Society, Seattle, Washington, USA.

1983 Invited panelist on "Liver Support/Transplants and Artificial Organs", Annual meeting of the American Society for Artificial Organs, Toronto, Ontario.

1983 Invited speaker on "Clinical Trial on Hemoperfusion" in Workshop on Hemoperfusion organized by Hopital Necker, Paris, France.

1983 Invited lecturer on "Basic Principle of Artificial Cells for Blood Substitutes" in symposium on Artificial Blood, Annual Meeting, Canadian Society of Immunohematologists, Ottawa, Ontario, Canada.

1983 Invited speaker, Pediatric Research Symposium and Workshop. Faculty of Medicine, University of Alberta, Edmonton, Alberta.

1983 Invited speaker on the Composite Artificial Kidney Reviews of indications and applications, Societe Quebecoise de Nephrologie Annual Scientific Meeting, Val David, Quebec.

1983 Invited speaker on Artificial Cells in the Newest in Drug Delivery Systems, Pfizer Dialogue, Annual Meeting, Association of Faculties of Pharmacy of Canada.

1983 Invited speaker on "Composite Artificial Kidney in Uremic Patients" Symposium on Hemoperfusion, Amsterdam, Holland. (Paper read in absence by Dr. P. Barre)

1983 Invited lecturer on "Artificial Cells", 57th Colloid and Surface Science Symposium, Toronto, Ontario.

1983 Invited speaker on "Artificial Cells", Symposium, Canadian Society of Cell Biology, CFBS, Ottawa, Ontario.

1983 Invited lecturer on "Artificial Cells", International Symposium on Biomaterials in Artificial Organs, Scotland.

1983 Invited speaker on Membrane Biotechnology in Artificial Cells in "Membrane

Technology Conference", Oregon, USA.
1983 Invited speaker on "Artificial Cells", "Hemoperfusion in Uremia", "Hemoperfusion in Poisoning and Fulminant Hepatic Failure", Brazil National Society of Nephrology Congress on Hemodialysis and Transplantation.
1983 Session chairman and invited speaker, V International Symposium on Hemoperfusion and Artificial Organs, People's Republic of China.
1983 Invited speaker, Nankai University, Tianjin, People's Republic of China.
1983 Invited speaker, Chongqing Medical College and Chongqing Biomedical Engineering Society, Chongqing, People's Republic of China.
1983 Invited speaker, Shanghai First Medical College, Shanghai, People's Republic of China.
1983 Invited speaker, Institute of Biochemistry, Shanghai, People's Republic of China.

1984 Invited speaker and session chairman, Gordon Research Conference on "Drug Carriers in Biology and Medicine".
1984 Invited speaker, Biocatalysis Group, University of Iowa, Iowa, Ill.
1984 Guest Faculty, Postgraduate Medicine course on "Life Support Systems in Intensive Care", University of Michigan Medical School, Ann Arbor, Michigan.
1984 Invited lecturer, NATO Advanced Study Institute on Biopolymer, Turkey.
1984 Guest speaker, "Artificial Cells" Medical Grand Round Montreal General Hospital.
1984 Invited speaker in Seminar on "Hemoperfusion in Hemodialysis Patients", NJ, USA.

1985 Chairman of session on Immobilized Cells, 8th Biannual International Enzyme Engineering Conference, Denmark.
1985 5th Congress of International Society of Artificial Organs, Chicago, USA.
Chairman, Program Committee on "Artificial pancreas/artificial liver".
Chairman, Workshop on "Artificial Cells".
1985 Invited Speaker, Science Council of Canada/Canadian Plastics Institute Meeting on "Emerging Technologies", Toronto.
1985 Invited Lecturer, "Artificial Cells", DuPont Co., Wilmington, DE, USA.
1985 Invited participant: "Think Tank: The Bowel as a Kidney", Downstate Medical Center, Brooklyn, New York.
1985 Invited speaker "Artificial Cells in Medicine and Biotechnology", Montreal Physiological Society.
1985 VIth International Symposium on Hemoperfusion, Mexico
Honora ry president
Invited speaker.
1985 Invited speaker for special breakfast meeting on "Hemoperfusion in chronic renal failure and aluminum removal", 25th Anniversary of Chronic Dialysis" to honour Professor B. Scribner, Seattle, USA.
1985 Invited participant, Science Council Workshop on Medical Devices, Toronto.
1985 Opening Plenary Lecturer, State art on "Artificial Blood", Annual Meeting of American Society of Artificial Internal Organs, Atlanta, USA.

1986 Invited speaker, International Conference on "Applications of New Technologies in Phospholipid Thin Membranes and Vesicles", US Naval Research Symposium, Tenefrice, Spain.
1986 Honorary President of Symposium, Cochairman, Program Committee, and invited speaker, 7th International Symposium on Hemoperfusion, Kiev, USSR, sponsored by the USSR Academy of Sciences, September.
1986 Invited speaker, Czechoslovakia Society of Nephrology and Czechoslovakia Academy of

Sciences, Prague.

1986 Special invited lecturer and session chairman, Annual Meeting of the Controlled Release Society, Virginia, USA.

1986 Chairman of two sessions, invited speaker and Program Committee on Artificial Kidney "International Symposium on Biomedical Engineering, Artificial Organs, and Transplantation" to honour Professor W. Kolff, Utah, USA.

1986 Invited speaker, Gordon Research Conference on "Bioactive Polymeric Material in Biomedical and Agricultural Application", Oxnard, California.

1986 Invited speaker, Workshop on Drug and Enzyme Delivery Systems, Annual Meeting of the American Society of Artificial Internal Organs, U.S.A.

1986 Invited speaker on "Artificial Cells" Workshop on Biotechnology, Canadian Society of Biological Sciences, Guelph, Ontario.

1987 Chairman of Symposium and Opening Plenary speaker, III International Symposium on Blood Substitutes, Montreal.

1987 Chairman, panel on Blood Substitutes, Annual Meeting, American Society of Artificial Internal Organs, New York.

1987 Panel Chairman and invited speaker, panel on "Drug Delivery", 6th Congress of the International Society of Artificial Organs.

1987 Invited Speaker on "Immobilization of enzymes, liver cell cultures and hemoglobin" in Session on Medical Applications, 9th International Conference on Enzyme Engineering, Santa Barbara, California.

1987 Invited speaker and International Scientific Committee, International Symposium on Optimization of Blood Purification, Rostock.

1987 Invited plenary lecturer and chairman of session, 7th International Symposium on Microencapsulation, Zegreb, Yugoslavia.

1987 Invited speaker, NATO Workshop on Immobilized Enzymes, Italy.

1987 Invited panelist, Symposium on "Role of Hemoperfusion in acute liver failure", Georgetown University, Washington.

1987 Invited Guest speaker, American Society on Material (Edmonton, Alberta).

1987 Invited speaker, Grand Round, Faculty of Medicine, University of Alberta,Edmonton.

1987 Invited speaker, Southwestern Research Institute, San Antonio, Texas, USA.

1987 Invited Speaker. Conference on Innovations in Protein modifications in therapeutics.

1988 Opening Ceremony State Art Lecturer on "Artificial Cells" 1988 Congress of the European Society for Artificial Organs, Prague, Czechoslovakia.

1988 Honorary President and Opening Ceremony Festive Lecturer on "Artificial Cells" 8th International Symposium on Hemoperfusion, Adsorbents and Immobilized Bioreactants, Rostock, Germany.

1988 Invited Speaker, session on Cell Biotechnology "Artificial Cells and Liposomes", 4th International Congress of Cell Biology, Montreal.

1988 Special invited speaker on "Artificial Blood". Symposium, Mexico City, Mexico.

1988 Invited lecturer on "Blood Substitutes". Mexican Academy of Surgery, Mexico City.

1988 Invited lecturer on "Blood Substitutes". Medical Centre, Mexico City, Mexico.

1988 Chairman of session and introductory lecture Gordon Research Conference on "Drug Carriers" New Hampshire, USA.

1988 Invited Speaker, Panel on New Trends in Artificial Organs, III World Biomaterials Congress, Kyoto, Japan.

1988 Special invited speaker on "Clinical Applications of hemoperfusion in intoxication and hepatic coma". Symposium, Mexico City, Mexico. 1988 Invited Lecture on Artificial

Cells, Shiga University, Japan.
1988 Invited Speaker International Congress on "New Trends in Nephrology, Dialysis and Transplantation". 9th Centenary, University of Bologna,Bologna, Italy.
1988 Session chairman, Artificial liver/pancreas, Annual Meeting of the American Society Artificial Internal Organs, Reno, USA.
1988 Invited lecturer in symposium on Mimetic Enzymes. Annual Meeting of the American Chemical Society, Toronto.
1988 Invited keynote lecture, Hybrid Artificial Organs Symposium, Bordeau, France.

1989 Honorary president and invited speaker, 9th International Symposium on Hemoperfusion, adsorbents and immobilized bioreactants, Tokyo, Japan.
1989 Invited lecturer, Plenary session on "Enzyme Engineering in Medical Field". 10th International Conference on Enzyme Engineering, Kashikojima, Japan.
1989 Symposium Co-chairman, Invited lecturer, and Chairman of session, "In vitro and in vivo assessments of cross linked hemoglobin" in International Symposium on Red Blood Cell Substitutes. San Francisco, U.S.A.

1989 Invited speaker and chairman of session, International Symposium on Red Blood Cell Substitutes sponsored by the Japanese Red Cross Society.
1989 Invited lecturer. "Immunological aspects of modified hemoglobin as blood substitute" Biomedical Engineering Society, Symposium on "Blood Substitutes". Federation of American Biological Sciences, New Orleans, U.S.A.
1989 Invited lecturer, "Modified hemoglobin: in vivo studies" American Trauma Society Annual Meeting, Florida, USA.
1989 Invited lecturer, Red Blood Cell Substitutes, Waseda University, Tokyo Japan.
1989 Invited speaker "Modified Hemoglobin as Blood Substitutes past, present and future", Immunohematology Society, Canadian Red Cross Symposium on "Present Trends in Blood Transfusion", Banff, Alberta.
1989 Chairman and speaker, Workshop on Blood Substitutes, European Society of Artificial Organs, Brussels, Belgium.
1989 Invited speaker on Blood Substitutes, Montreal Red Cross Society, Montreal.
1989 Invited speaker, Biotechnological and Medical applications of Artificial Cells in International Conference on Biotechnology, Slamanca, Spain
1989 Invited lecturer, Biotechnology of Artificial Cells, Department of Chemical Engineering, Unviersity of Salamanca, Salamanca, Spain

1990 Honorary president and invited plenary speaker, X International symposium on Hemoperfusion, absorbent and immobilzed bioreactants, Rome, Italy
1990 Invited plenary speaker on Biotechnoligcal apporach based on artificial cells, Congress of the European Society for Artificial Organs , Bologna, Italy
1990 Invited plenary speaker, VI International Symposium on Microencapsulation, Glasgow
1990 Invited speaker on Artificial Cells. "International Conference on Membrane," Chicago, IL
1990 Invited speaker, symposium, American Chemical Soceity, Annual Meeting, Washington, DC, USA

1991 Invited speaker in panel on Hydribd Artificial Organs, Annual Meeting, American Society of Artificial Internal Organs, Chicago USA.
1991 Invited speaker and session chairman on "Blood Substitutes"; Annual Meeting, American Society of Artificial Internal Organs, Chicago, USA.
1991 Invited speaker, On "Red Blood Cell Substitutes by Modified Hemoglobin", CPTMQ

CSLT Congress, Montreal.

1991 Congress President VIII World Congress, International Society of Artificial Organs, Montreal, Canada. Opening ceremony speaker on "35 years of artificial cells"

1991 Symposium Chairman and plenary speaker, on "Modified hemoglobin as blood substitutes", IV International Symposium on Blood Substitutes, Montreal, Canada.

1991 Invited lecturer on "Modified hemoglobin as blood substitutes", Symposium on "New Concepts in Blood Product Usage", Canadian Society of Hematology and Canadian Red Cross Blood Service, Annual Meeting, Royal College of Physicians of Canada, Quebec City.

1992 Chairman of panel on "Blood substitutes", and speaker on "Modified hemoglobin and clinical safety", American Society for Artificial Internal Organs, Annual Meeting, Memphis, USA.

1992 Invited plenary speaker on Blood Substitutes., XIX Congress of the European Society for Artificial Organs,Rhode Island, Greece.

1992 1st Julius Silver Lectureship, Julius Silver Symposium organized by the Julius Silver Institute of Biomedical Engineering, Technion Institute, Israel and the Israel Society of Biomedical Engineering. International

1992 Invited speaker, 8th International Symposium on Microencapsulation, Dublin,Ireland,

1993 Co-chairman and invited plenary speaker, V International Symposium on Blood Substitutes, San Diego, California, USA.

1993 Chairman and opening speaker, IB Conferenc on Blood Substitutes, Philadelphia, USA.

1993 Open plenary lecturer, Inaugurative congress of the founding of the Japanese Society for Blood Substitutes. Tokyo

1994 Honorary Congress President and Opening Plenary Speaker, XI Congress of the International Society for Artificial Cells, Blood Substitutes and Immobilization Biotechnology, with Professor R. Langer of MIT as organizer and congress president,Boston, USA.

1994 Conference Chairman and Opening Speaker IBC conferenece on Blood Substitutes. Washington, D.C.

1994 Invited speaker, on Blood Substitutes International Conference on Bioengineering, Krems, Austria.

1995 Invited speaker on "Artificial Cells Technologies" Meeting on Cell Transplantation. Technologies Applicable to Cell Therapy, Miami, U.S.A.

1995 Invited speaker Symposium on Tissue Engineering using Biomedical Polymers. Kyoto

1995 Invited Main Lecturer. (at last minute substituted by my recent Ph.D. graduate beccause too many invited lectures this year.) International Symposium on Polymer, Institute of Macromolecular Chemistry,Czech Academy of Science, Prague, Czech.

1995 Invited Special Lecturer on "Present Status of Modified Hemoglobin as Blood Substitutes" II Congress Japanese Society for Blood Substitute, Tokyo, Japan. This was followed by Invited Lecturer on "Specially desig ned modified hemoglobins" Waseda University,Tokyo and also Shonan Research Centre, Tokyo.

1995 Panel Chairman and opening speaker. Panel on Artificial Blood. Annual Meeting of the American Society for Artificial Internal Organs, Chicago.

1995 Chairman , Symposium on Tissue Engineering I: Basic Science and Chairman, Session Tissue and Cellular Engineering, 17th Annula International Conference of the IEEE Engineering in Medicine and Biology society & 21 Canadian Medical and Biological

Engineering Conference, Montreal.

1995 Presidential address & Key note speaker on "Artificial Cells Biotechnology for Artificial Organs in the 21st Century". X World Congress of the International Society for Artificial Organs, Taipei, Taiwan.

1995 Opening speaker on "Present status of modified hemoglobin blood substitutes" International Symposium on the Technology of Blood Substitutes. Taipei, Taiwan.

1995 Invited Plenary lecture on "Microcapsule artificial cells containing enzyme, hepatocytes or genetically engineered microorganisms: implications in therapy and biotechnology" in the International Symposium on Microencapsulation, Drug Dynamics Institute, College of Pharmacy, U of T at Austin, Texas, U.S.A.

1996 Cochairman and invited speaker Session on "Safety and Efficacy of Artificial Oxygen Carrier" 24th Congress of the International Society of Blood Transfusion, Chiba, Japan.

1996 Co-chairman and invited speaker on "Deveopment of bioartificial liver" in Symposium on "Plasmapheresis and/or transplant for fulminant hepatic failure" International Conference for Apheresis. Kyoto, Japan.

1996 Co-chairman Session on Blood Substitutes. Annual meeting of the American Society for Artificial Internal Organs, Washington,D.C.

1996 Symposium Chairman and opening speaker, VII International Symposium on Blood Substitutes, Montreal

1996 Invited opening plenary speaker: Conference on Bioartificial Organs, Science and Technology, Sponsored by the Engineering Foundation, Nashville,Tennessee, USA

1997 Hononary congress president and plenary lecturer. XII Congress of the International Society for Artificial Cells, Blood Substitutes and Immobilization Biotechnology. Organized by the Chinese Academy of Medical Sciences ,Beijing, PRC. September.

1997 Symposium co-chairman and plenary lecturer of the VIII International Symposium on Blood Substitues, Tokyo, Japan.

1997 Invited speaker and co-chairman of session on Artificial Cells & Blood Substitutes. Congress of the International Society for Artificial Organs. Rhode Island, U.S.A.

1997 Invited speaker, Symposium on Blood and Surgery : a Multidisciplinary approach, Winnipeg, Canada.

1997 Keynote speaker, "Blood substitutes - present status and future relevance in national blood supply policies" Canadian Society for Transfusion Medicine, Ottawa.

1998 Invited opening plenary lecture on "Artificial Cells, Immobilization and Encapsulation", Bioartificial Organs II: Technology, Medicine and Materials, Engineering Foundation Conferences, Banff, Canada.

1998 Invited Plenary Lecturer on " Artificial Cells including Blood Substitutes" 8th Asian-pacific Congress of Clinical Biochemistry, Kuala Lumpur, Malaysia

1998 Invited "State of the art lecture" on hemoglobin-based blood substitutes. XXVth Congress of the Int. Soc of Blood Transfusion. Oslo, Norway,

Panel speaker on “Polyhemoglobin-catalase-superoxide dismutase: a new blood substitute” Conference on Resuscitation Fluids, Institute of Medicine, National Academy of Science, Washington, D.C.

1999 Chairman and opening speaker. Panel on Artificial Blood. Annual Meeting of the American Society for Artificial Internal Organs

1999 Invited lecturer on Blood Substitutes in Conference on Biotech Alternatives to Blood & Plasma Products. London, UK

1999 Invited lecturere and chairman of panel on "Bioencapsulation" Innovation and Trends in Biotechnology, Laval, Quebec, Canada,
1999 Invited lecturer on "Artificial Cells including blood substitutes", Therapeutic Products Program, Continuing Education, Health Canada, Ottawa, Canada
1999 Invited speaker in symposium on "The bowel as an artificial kidney" Congress of the International Society for Artificial Organs, Edingburgh, UK.
1999 ISBP Award Plenary Lecture, Congress of the International Society for Blood Purification, Prague. (Sir Roy Calne was the winner of the 1998 ISBP Award Lecturer other previous winners have included Robert Rosenberg at the NIH, and Charles Dinarello then at Tufts)

2000 Invited Lecturer on Artificial Cells, Abbott Laboratory, Chicago
2000 Invited Lecturer on Blood Substitutes, International Conference on Transfusion Medicine 2001, Cambridge University, United Kingdom
2000 Invited Lecturer on Blood Substitutes, European Society for Trauma Surgery, Pisa, Italy
2000 Invited Plenary Speaker, Bionics for Human in 3rd Millenium, L'Aquila, Italy
2000 Chairman, Session on Award Lectures, Congress of the International Society for Blood Purification, Rome, Italy
2000 Session Chairman on Clinical Trials and Invited Lecturer on Present Status(1)Blood Substitutes (2) Oral therapy for uremia, III Bioartificial Organ Conference, Switzland
2000 Symposium Co-chairman, session chairman and invited plenary lecturer on New Products in hemoglobin based blood substitutes, VIII International Symposium on Blood Substitutes, San Diego
2000 Invited Lecturer, Poly2000, American Chemical Society, Hawaii

2001 Invited Open Plenary Symposium lecturer on Artificial Cells in the 48th Annual Conference, American Society for Artificial Internal Organs, New York City, U.S.A..
2001 Invited speaker on "Blood Substitutes" 11th European Congress of Anaesthesiology, Florence. Italy.
2001 Chairman & Invited Speaker in panel on "Artificial Organs". 6th Symposium of World Artificial Organs, Immunology & Transplantation Society, Ottawa, Canada
2001 Invited Speaker in panel on "Treatment of Type 1 Diabetes", 6th Symposium of World Artificial Organs, Immunology & Transplantation Society, Ottawa, Canada
2001 Panelist in public panel on "Ask the Experts". 6th Symposium of World Artificial Organs, Immunology & Transplantation Society, Ottawa, Canada
2001 13th Congress of the International Society for Artificial Organs, Osaka, Japan. International Scientific committee, chairman of Panel session on "Genetic Engineering and Biotechnology in Artificial Organs", and invited panel lecturer on "Artificial Cells for genetically engineered cells and modern biology in artificial organs"
2001 Invited speaker on Artificial Cells as visiting professor, Chinese Hong Kong University Medical School.
2001 Invited speaker on Artificial Cells. Capital Medical School Affiliated ChouYaung Hospital, Beijing.

2002 Invited lecturer on "Artificial Cells in Tissue Engineering with emphasis on oral therapy using artificial cells containing genetically engineered cells". Tissue Engineering Conference, Pittsburg, Penn.
2002 Invited plenary speaker on "Future generations of Blood Substitutes" and member of Organizing committee of Conference on Blood Substitute organized by Karolinka

Institute, Stockholm, Sweden.

2002 Keynote speaker on "Artificial Cells in Biotechnology and Medicine", World Congress. Seoul, South Korea.

2002 Invited lecturer on "Blood Substitutes in trauma surgery:". International Congress of Surgery, Taiwan.

2002 Invited Keynote speaker on "Artificial Cells in Bioencapsulation: macro, micro, nano and molecular", Bioencapsulation Conference, Birmingham, U.K.

2002 Invited speaker on "Two new blood substitutes: polyhemoglobin-SOD-CAT and biodegradable polymeric Hb nanocapsules", Mini symposium on Oxygen carrying resuscitation fluid, ATACCC, Florida, U.S.A.

2003 Invited Special Plenary speaker on Artificial Oxygen Carriers, International Symposia for Life Science and Medicine, Keio University, Tokyo, Japan (March)

2003 Honorary president and invited plenary speaker, 9th International Symposium on Blood Substitutes, Tokyo, Japan (March)

2003 Invited Speaker, Symposium, Research Fund Bayer/Canadian Blood Service/Hema Quebec

2003 Invited speaker on Artificial Cells in Medicine and Biotechnology. CIHR Workshop Regenerative Medicine and Artificial Organs, Toronto, Canada. (March)

2003 Chairman and invited speaker, precongress workshop on Blood Substitutes: present and future. Joint congress of International Society for Artificial Organs/American Society for Artificial Internal Organs. Washington D.C., U.S.A. (June)

2003 Invited Speaker on "Blood Substitutes & Artificial Cells" 4th Regenerative Medicine Conference , Washington, D.C. (November)

2003 Visiting Professor, Invited Lecture on Blood Substitutes, Grand Round, Department of Anesthesia and Critical Care, Massachusetts General Hospital, Harvard Medical School, Boston, U.S.A. (December).

2003 Invited plenary speaker. TEDA-Waston International Biotechnology Conference, Tianjin , PRC

2003 Invited speaker. Life Sciences Faculty, Nankai University, Tianjin, PRC

2003 Invited speaker. Chinese Academy of Medical Sciences/ Beijing Union Medical College. Beijing, PRC

2003 Invited speaker. Pharmaceutical Sciences and Biotechnology Faculty,Tianjin University, Tainjin, PRC

2004 Keynote speaker, Graduate Program Conference, Department of Pharmaceutical Sciences, University of Toronto, Canada.

2004 Invited speaker, VIP guest, scientific committee, the 3rd TEDA-WATSON International Forum on Biotechnology and Biomedicine, Tianjin, China

2004 Invited plenary speaker and Investiture as Visiting Professor Shen Zhen University, National Symposium on Hemoperfusion. ShenZhen, China

2004 Keynote speaker, 5th International European Molecular Biology Laboratory Ph.D. Students' Symposium. European Molecular Biology Laboratory (EMBL),Heidelberg, Germany

2004 Invited plenary lecturer, International Conference on Chemistry Biology Interface: Synergistic New Frontiers. Delhi, India.

2005 Honorary Sympoium President and invited opening plenary speaker on "Evolution of Artificial Cells", X International Symposium on Blood Substitutes, Rhode Island, Providence, U.S.A.

2005 Keynote Speaker on "Artificial Cells in Regenerative Medicine" II World Congress Regenerative Medicine, Lipzig, Germany

2005 Invited speaker on "Blood Substitutes: molecular biotechnology to nanobiotechnology" International Conference on New Technologies in Medicine, Krems, Austria

2005 Invited speaker on "Artificial Cells of macro, micro, nano and molecular dimensions" Department of Biomedical Engineering Seminar Series , McGill Unversity.

2006 Invited speaker on "New Trends in Blood Substitutes: biological and synthetic oxygen carriers". Joint Conference of the Canadian Society for Transfusion Medicine/Canadian Blood Service/Hema-Quebec, Montreal.

2006 Invited Speaker, Biomedical Engineering Department Seminar Series, McGill University.

2006. Opening Plenary lecturer for the 3 days Business Conference section of the 9th International Conference on "Gene and Drug Therapy in Molecular Medicine" Crete, Greece. "Therapeutic Application of Polymeric Artificial Cells"

2006 Invited opening session lecture on "Therapeutic applications of polymeric artificial blood cells" International visions on blood substitutes. Hemoglobin-based oxygen carriers, from chemistry to clinic" University of Parma, Parma, Italy.

2006 Invited speaker: Technology in Liver Regeneration Conference on Stem Cells in Regenerative Medicine, Ankara, Turkey.(cancel because of airline security problem)

2006 Invited speaker on nano artificial red blood cell to the Nanoscience Group, University of Duisburg-Essen in Western Germany (Postponed because of airline security problem)

2007 Invited Opening keynote lecturer, 2007 Oct XI International Symposium on Blood Substitutes, Organized by Chinese Academy of Medical Sciences and Beijing Union Medical College, Beijing, China

2007 Chairman and panelist, Satellite symposium of XI ISBS on Toxicology of Blood Substitutes, Xian, China.

2007 Invited Opening keynote lecturer, XI International Symposium on Blood Substitutes, Organized by Chinese Academy of Medical Sciences and Beijing Union Medical College, Beijing, China

2007 Co-Chairman and panelist, Satellite symposium of XI ISBS on Toxicology of Blood Substitutes, Xian, China.

2007 Invited Speaker, Faculty of Medicine, Shantou University, Shantou, China

2007 Visiting Professor and invited speaker, Northwest University in Xian, China

2008 Invited lecturer , International Conference on Drug Designand Discovery, Dubai, UAE Dubais invited speaker

2008 International Drug Discovery Science & Technology Conference (IDDST) Opening keynote session in seesion on Regnerative Medicine, Beijing, Chinag.

2008 Plenary specker and chair of session, International Academy of Nanomedicine Symposium, Washington DC (Potomac MD) USA

2008 Guest Professor award ceremony and invited lecture. Shantou University, Shantou, China

2008 Plenary Keynote speaker, World Congress on Cancer, Shanghai, China (did not go because of unexpected illness)

2008 Invited Keynote speaker, Joint meeting of the 15th Japanese Soceity for Blood Substitutes and 6th Current Issues in Blood Substitutes, Keio University, Tokyo, Japan (did not go because of unexpected illness)

2009 Honorary President, opening speaker, invited speaker and panelist, XII International Symposium on Blood Substitutes, Parma, Italy.

2009 Opening plenary lecturer, First World Congress of the International Academy of Nanomedicine, Hainan, China
2009 Special invited speaker, Chinese Research Group on Blood Substitutes, Beijing China, Chinese Academy of Sciences.
2009 Invited plenary lecturer, 2nd Science Conclave of Nobel Laureates, Allahabad,India.

2010 Opening Keynote plenary lecturer, 2nd World Congress of the International Academy of Nanomedicine, Antelya, Turkey
2010 Opening Keynote plenary lecturer. International Congress on Nanotechnoloy, Ottawa
2010 Opening Keynote plenary lecture BIOMED2010, Istanbul
2010 Opening Keynote plenary lecturer BIT 3rd Congress on Regenerative Medicine and Stem Cells, Shanghai, China.
2010 Opening Keynote plenary lecturer BIT 1st Congress on Nanomedicine, Beijing, China
2010 Invited Lecture, Tsinghua University, Beijing, China
2010 Invited Lecture, Peking University Health Sciences, Beijing, China
2010 Invited Lecture, Polytech University, Hong Hong, China
2010 Invited Lecture, Transfusion Institute, Beijing, China

2011 Acceptance speech for being voted the "Greatest McGillian" in McGill University's 190 years history. Result of a worldwide poll to vote on 700 nominee and 20 finalists to celebrate the 190th anniversary of McGill University.
2011 Kjeldgaard Lecturer, Department of Molecular Biology, Aarhus University,Denmark
2011 Honorary president and opening lecture, XIII International Symposium of Blood Substitutes, Mass General Hospital, Harvard Medical School, Boston, Symposium president is Professor W Zapol, previously chief of Critical Care and Anesthesiology at at Mass General Hospital of Harvard Medical School. http://www.medicine.mcgill.ca/artcell/536.pdf
2011 Opening Keynote Speaker, Conference on Micro and Nano Systems, Chongqin, China
2011 Invited Speaker, Blood Transfusion Institute of the Chinese Academy of Medical Sciences and Peking Union Medical College.
2011 Invited Speaker, Ordos Blood Substitute Congress, Ordos, Inner Mongolia, China

2012 Opening Keynote lecturer on Frontier in Transfusion Medicine based on nanobiotechnological blood subsitutes, BIT International Congress on Hematology, Beijing, China.
2012 Invited lecturer, Microcirculation Institute of the Chinese Academy of Medical Sciences, Beijing, China
2012 Invited lecturer, Beijing Transfusion Institute, Beijing, China
2012 Opening Keynote Lecturer and honorary president , III International Academy of Nanomedicine Congress, Ankara, Turkey.
2012 Invited Speaker, XX Conference on Bioencapsulation, Ontario, Canada

2013 Opening Plenary lecturer and Honorary Symposium President of the XIV International Symposium on Blood Substitutes and Oxygen Therapeutics. at the Blood Transfusion Institute of the Chinese Academy of Medical Sciences, China. Symposium president is the president of the Chinese Academy of Medical Sciences and the other honorary symposium president is the vice minister of health of China.
2013 "Fronteir in Medicine" lecture series, Shantou University Medical School. Title of lecture "Blood substitutes in transfusion medicine: present clinical status and future perspectives"

2013 "Distinguished speaker lecture series" title of lecture "Artificial Cells" Calgary University Biomedical Engineering group
2014 Opening Plenary Lecturer 3rd Congress of the International Society for Nanomedical Science (postpored because of unsettle condition in region)
2015 Honorary President and invited speaker on *Nanobiotherapeutics with enhanaced rbc functions*, 4th Congress of the International Society for Nanomedical Sciences, Turkey
2015 Honorary Presdient and invited speaker on Red blood cell replacement or Nanobiotherapeutics with enhanaced rbc functions?, XIV International Symposium on Blood Substitutes, Lund, Sweden
2015 Invited lecturer on Blood substitutes and nanobiotherapeutic Blood Transfusion Institute of the Chinese Academy of Medical Sciences
2015 Invited lecturer on Blood substitutes: Present status and future perspectives Tianjin International Biotherapeutic Research Institute, Tianjin, China.

2016 Declined invitations because of world situation

PATENTS and PATENT APPLICATIONS:

1. T.M.S. Chang (1970) "Nonthrombogenic Microcapsules": U.S. Patent, 3, 522, 346
2. T.M.S. Chang, F.C. MacIntosh and S.G. Mason (1971) "Encapsulated hydrophilic compositions and Methods of Making them" Canadian Patent, 873, 815
3. T.M.S. Chang (1971) "Nonthrombogenic microcapsules" Canadian Patent, 876,100
4. T.M.S. Chang (1973) "Blood compatible microcapsules containing detoxicants" U.S. Patent, 3, 725, 113
5. T.M.S. Chang (1976) "Blood compatible microcapsules containing detoxicants" Canadian Patent, 982, 941
7. T.M.S. Chang and J. Daka (1990) "A novel method for bilirubin removal" Canadian Patent granted.
8. T.M.S. Chang, L. Bourget and C. Lister (1991) Novel method of amino acid removal by immobilized bioreactant based on new findings of enterorecirculation of amino acids USA Patent No. 5,147,641, Issued Sept. 15, 1992
9. T.M.S. Chang, L. Bourget and C. Lister (1989) Patent as above, Canada
10. T.M.S. Chang and H. Wong (1992) A novel method for cell encapsulation in artificial cells. USA Patent No. 5,084,350, Issued Jan. 28, 1992
11. T.M.S. Chang and C. Lister (1993) Screening test for modified hemoglobin blood substitute before use in human. U.S. Patent No. 5,200,323, Issued April 6, 1993
12. T.M.S. Chang and W.P. Yu (1992). Biodegradable polymer membrane containing hemoglobin as potential blood substitutes. British Provisional Patent No. 9219426.5, Issued September 14, 1992.
13. T.M.S. Chang and W.P. Yu (1997). Biodegradable polymer membrane containing hemoglobin for blood substitutes. U.S.A. Patent 5670173 September, 23, 1997
14. D'Agnillo F & TMS. Chang (1997) Modified hemoglobin blood substitute from Cross-linked hemoglobin-superoxide dismutase-catalase.US patent 5,606,025, Feb,1997
15. D'Agnillo F & T.M.S.Chang Hemoglobin-enzyme complexes. Canadian Patent 2,135,739
16. Satya Prakash & T.M.S.Chang (1996) Microencapsulated genetically engineered microorganisms for clinical application. British Priority Patent No 9601333-9, January 23, 1996

16 T.M.S.Chang & Satya Prakash(1998) Microencapsulated genetically engineered microorganisms for clinical application. International PTC application for Europe, Japan,

U.S.A.& Canada.(removal of urea and ammonia)

17 Satya Prakash & T.M.S.Chang (April, 28,1999). Microencapsulated genetically engineered E. Coli DH5 cells for the removal of undesired electrolytes and/or metabolites. U.S.A. Provisional Application. Serial Number 60/131,468

18 Satya Prakash & TMS Chang (April 27, 2000) Artificial Cells Microencapsulated Genetically Engineered E. Coli DH5 Cells for the Removal of Undersired electrolytes and/or metabolites. International Application No:PCT/CA00/00482

19 TMS Chang & Satya Prakash (2001) Microencapsulated genetically engineered microorganisms for clinical application. U.S. Patent 6,217,859 April 17 2001.

20 TMS Chang & Satya Prakash (2001) Microencapsulated genetically engineered microorganisms for clinical application. Japanese Patent 3228941 (September 7 2001).

21 TMS Chang, & WP Yu (2001) Biodegradable Polymeric Nanocapsules and uses thereof. U.S. Provisional Patent Application. No 60/316,001 (August 31, 2001)

22 TMS Chang, D.Powanda & WP Yu (2002) Biodegradable Polymeric Nanocapsules and uses thereof. International Patent Application No. PCT/CA02/01331- August 2002. WO 03/017989 A1 (2003)

23 TMS Chang, D.Powanda & WP Yu (2002) Biodegradable Polymeric Nanocapsules and uses thereof. Chinese Patent Application 2004

24 TMS Chang & Binglan Yu (2002) Composition for inhibiting tumour growth and methods thereof. US Provisional Patent Application 60/364,581 (March 18, 2002)

25 TMS Chang & Binglan Yu (2003) Composition for inhibiting tumour growth and methods thereof. US Patent Application (March 2003)

26 T.M.S. Chang and C. Lister (2003). Screening test for modified hemoglobin blood substitute before use in human. Canadian Patent (awarded)

27 TMS Chang, D.Powanda & WP Yu (2004) Biodegradable Polymeric Nanocapsules and uses thereof. U.S. Patent Application February 27 2004

28 TMS Chang, D.Powanda & WP Yu (2007) Biodegradable Polymeric Nanocapsules and uses thereof. Chinese Patent awarded

29 TMS Chang & Wong, N (2007) A novel blood substitute. U.S. Provisional Patent.60/968,720 August 29, 2007

30 TMS Chang, & WP Yu (2008) Biodegradable Polymeric Nanocapsules and uses thereof. U.S. Patent Awarded Nov 2008

31 TMS Chang & YZ Bian (2011) Novel Blood Substitute with complete red blood cell functions. U.S. Provisional Patent US 61/490.304

32 TMS Chang & YZ Bian (2013) Novel Blood Substitute with complete red blood cell functions. Canadian Patent Application

33 TMS Chang & YZ Bian (2013) Novel Blood Substitute with complete red blood cell functions. Chinese Patent Application

COMMITTEES AND BOARDS:

1. Diocesan Boys' School, Hong Kong:
   - Head Prefect of Boarding School.
   - Captain, Featherstone House (sports).
   - Pianist, General Assembly and Chapel services.
2. McGill University Undergraduate:
   - Social Convenor and Student Council, Douglas Hall of Residence, McGill.
   - McGill Intercollegiate Wrestling Team (Letter award).

Sunday School Teacher, Christ Church Cathedral, Montreal.

3. Free voluntary community service in Montreal Chinese Hospital:
   First of the annually rotating chairmen, Medical Board, newly built Montreal Chinese Hospital (free voluntary service) (1966-1967).
   Attending staff and chief of laboratory (free voluntary service) (1966 until Medicare in Quebec);
   Consultant – free voluntary service (since Medicare started until 1982);
   Honorary Consultant ,free voluntary service (1982-1987);
   Honorary Staff , free voluntary service (1987- present).
4. Board of Directors, Preville Presbyterian Church (1967-1968).
5. Advisory Board, Biannual International Enzyme Engineering Conference (1971).
6. Committee on the Standardization of Nomenclature in Enzyme Technology, (consisting of E Katchalski, Y Levin & A Patchornik from Israel; J Porath & K Mosbach from Sweden; MD Lilly from the UK; G Manecke from Germany; PV Sundarum from India; NO Kaplan, VH Edwards, AE Humphrey, EK Pye, HH Weetall & LB Wingard, Jr. from the USA; & TMS Chang from Canada (1971 +1973).
7. Canadian National Committee, National Research Council of Canada, International Union of Pure and Applied Biophysics (1971-1975).
8. Isotope Committee, McIntyre Building, McGill University (1967-1976).
9. Ad Hoc Committee on Contracts from Drug Systems, National Institute of Child Health and Human Development, National Institutes of Health, Washington, DC (1972).
10. Postgraduate Awards Committee, Faculty of Medicine, McGill University (1972-79).
11. Advisory Board, Biannual International Enzyme Engineering Conference (1973).
12. Project Site Visit and Special Study Section, National Institutes of Health (USA) (1974).
13. Project Site Visit and Special Study Section, National Institutes of Health (USA) (1975).
14. Advisory Board, Biannual International Enzyme Conference (1975)
15. Consultant, National Institute of Child Health and Human Development, National Institutes of Health, Washington, DC (1975-1977).
16. Promotion, Reappointment and Tenure Committee, Dept of Physiology, McGill University (1975-1977).
17. Statutory Committee for Professors in Medicine, McGill University (1975).
18. Statutory Committee for Professors in Biochemistry, McGill University (1977).
19. Advisory Board, Biannual International Enzyme Engineering Conference (1977).
20. Chairman and Organizer, International Symposium on "Some Novel Approaches in Artificial Kidney, Artificial Liver and Detoxification", (1st International Symposium on Hemoperfusion) Montreal (1977).
21. Canadian Standard Association Subcommittee on Kidney Dialysis (1977-1987).
22. International Council Member, International Society for Artificial Organs (1977 982).
23. Scientific Film Comm., American Society for Artificial Internal Organs (1977).
24. Video Committee, American Society for Artificial Internal Organs (1977).
25. Program Committee, American Society for Artificial Internal Organs (1978-81).
26. Project Site Visit and Special Study Section, National Institutes of Health (USA) (1978).
27. Search Committee for Physiology Chairman, McGill University (1978).
28. McGill University Patent Policy Review Committee (1979).
29. McGill University Ad Hoc Committee on visiting scholars, fellows and students from China (1979).
30. Cochairman, 2nd International Symposium on Hemoperfusion, Israel Institute of Technology, Technion, Israel (1979).
31. Organizer and initiator, Canadian Society for Artificial Organs, Artificial Organs,

Artificial Cells and Medical Devices (1979).

32. Member of International Program Committee, Symposium on Control Aspects of Artificial Organs. International Federation of Automatic Control and International Society for Artificial Organs, Warsaw, Poland (1979-1980).
33. Co-chairman, Gordon Research Conference on "Drug Carriers in Biology and Medicine", New Hampshire, USA (1980).
34. Admissions Committee, Faculty of Medicine, McGill University (1979-1982).
35. Departmental Policy Committee, Dept. of Physiology, McGill Univ. (1979-1986).
36. Advisory Board, Biannual International Enzyme Engineering Conference, Japan (1981).
37. Founding President, Canadian Society for Artificial Organs, Artificial Cells and Medical Devices (1980-1982).
38. Standing Committee on Biotechnology, McGill University (1980-1981).
39. Biotechnology Research Group, Faculty of Graduate Studies and Research, McGill University (1981-1984).
40. Keyman on Hemoperfusion, Program Committee, International Congress of the International Society for Artificial Organs, Paris, France (1981).
41. Chairman, Gordon Research Conference on "Drug Carriers in Biology and Medicine", New Hampshire, USA (1982).
42. Honorary President, 4th International Symposium on "Hemoperfusion", Turkey and member of International Organizing Committee (1982).
43. Member, McGill University Regional Advisory Group of International Development Research Centre of Canada (IDRC) on People's Republic of China (1982-present).
44. Board of Trustees, International Society for Artificial Organs (1982-1986).
45. Symposium President and Chairman of Organizing Committee, Fifth International Symposium on "Microencapsulation, Including Artificial Cells", Montreal, Canada (1983).
46. Fifth International Symposium on "Hemoperfusion and Artificial Organs", People's Republic of China, International Scientific Committee (1983). Co sponsored by the Chinese Biomedical Engineering Society and the International Society of Artificial Organs.
47. Advisory Committee, VII International Conference on Enzyme Engineering, Engineering Foundation for 1983.
48. Organizing Committee and chairman of program committee on Hemoperfusion", 4th International Congress of the International Society of Artificial Organs, Kyoto, Japan (1983).
49. International Scientific Committee, International Symposium on Hemodetoxifications in Nonuremic patients, Italy (1983).
50. Chairman, International Committee of past symposium presidents, International Symposium on Hemoperfusion, sorbents and immobilized bioreactants series (1983 to present)
51. Consultant, Dialaid International Ltd. (1981-1984), which became Biomicroencapsulation Technology Ltd., Montreal (1984 to 1986), which became Carbomed, Co. (1986 1990).
52. Scientific Advisory Board, Karyon Technology Co., Boston, Mass, USA (1983 to 1986).
53. Honorary president, 6th International Symposium on Hemoperfusion (1985), and member of International Scientific Committee, Mexico. Co sponsored by the Mexican Society of Nephrology and the International Society of Artificial Organs.
54. Organizing Committee (past chairmen), Gordon Research Conference on "Drug Carriers

in Biology and Medicine", New Hampshire, USA (1984).

55. International Committee, NATO Advanced Study Institute on Biopolymer, Turkey (1984).
56. Advisory Committee, Biotechnology, McGill University (1984 to 1993).
57. 5th Congress of the International Society of Artificial Organs, Chicago, U.S.A. (1985) Chairman, Program Committee on "Artificial pancreas/artificial liver". Chairman, workshop on "Artificial Cells"; Specialty Chairman on "Plasmapheresis Blood Manipulation Field".
58. Chairman, Search Committee for Cardiovascular Physiologist, Dept. of Physiology, McGill University (1986).
59. Chairman, Advisory Committee Meeting on "Particulate Contamination in Medical Devices", Bureau of Medical Devices, Department of Health and Welfare, Government of Canada, Feb. 1986, Ottawa.
60. Honorary President, 7th International Symposium on Hemoperfusion, Kiev, USSR (1986). Sponsored by the USSR Academy of Sciences.
61. President, 3rd International Symposium on Blood Substitutes, Montreal, PQ, Canada (1987).
62. Committee on Appointment, Tenure and reappointment, Physiology, McGill (1983-85)
63. International Program Committee for the Joint World Congress of International Society of Artificial Organs and European Society of Artificial Organs, Munich, Germany, 1987.
64. International Program Committee: International Symposium on "Optimization of Blood Purification", Rostock GDR, 1987.
65. Program committee on Artificial Cells and Hemoperfusion. 1988 Congress of the European Society of Artificial Organs, Prague, Czechoslovakia.
66. Program Committee, Annual Meetings of the American Society of Artificial Internal Organs (1986 to 1992).
67. Program Committee, 7th International Symposium on Microencapsulation, 1987.
68. Scientific Advisory Board, Hemosol Co., Toronto, Canada.(1988-1998)
69. Member of Chairman"s Advisory Committee, Department of Physiology, McGill University (1988-present)
70. Honorary President, 8th International Symposium on Hemoperfusion, Sorbent and Immobilized Bioreactants, Germany, 1988.
71. Cochairman, 1989 International Symposium on Red Blood Cell Substitutes: Design and Clinical Application, San Francisco, U.S.A.
72. Honorary President, 9th International Symposium on Hemoperfusion, Sorbent and Immobilized Bioreactants, Tokyo, Japan, 1989.
73. Program Committee, 1989 Congress of the International Society of Artificial Organs, Sapporo, Japan.
74. Honorary President, 10th International Symposium on Hemoperfusion, Sorbent and Immobilized Bioreactants, Rome, Italy, 1990.
75. International Scientific Advisory Committee member, 7th International Symposium on Microencapsulation, Glasgow, Scotland, 1990.
76. Congress President, 8th World Congress of the International Society of Artificial Organs, in conjunction with the 4th International Symposium of Blood Substitutes, Montreal, 1991.
77. International Scientific Advisory Committee, 8th International Symposium on Microencapsulation, Ireland, 1992.
78. Member, McGill Biotechnology Committee (1984 to present).
79. Member, Subcommittee on Research Centers, Faculty of Graduate Studies (1991).
80. Board of Trustee, International Society of Artificial Organs. Reappointed for 1989

1993.

81. Honorary President, International Society for Artificial Cells and Immobilization Biotechnology (1991-present).
82. President-elect, International Society for Artificial Organs (1992-1994).
83. President, International Society for Artificial Organs (1994-1996).
84. International Scientific Advisory Committee, 9th International Symposium on Microencapsulation, Turkey,1993.
85. Honorary congress president, XI Congress of the International Society for Artificial Cells, Blood Substitutes and Immobilization Biotechnology. (Congress president Professor R.Langer of MIT which organized this), Boston,1994.
86. Conference Chairman IBC Conference on Blood Substitutes, Washington D.C. 1994
87. International Scientific Advisory Committee, 9th International Symposium on Microencapsulation, USA ,1993.
88. Program Chairman, International Organizing Committee, Xth World Congress of the International Society for Artificial Organs, Taipei, Taiwan (1995).
89. Chairman, VI International Symposium on Blood Substitutes. Montreal 1996.
90. Organizing Committee, Congress of the International Society for Artificial Organs, Rhode Island, U.S.A.
91. Cochairman, VI International Symposium on Blood Substitutes Tokyo, Japan 1997
92. Honorary congress president, XII Congress of the International Society for Artificial Cells, Blood Substitutes and Immobilization Biotechnology. Organized by the Chinese Academy of Medical Science with president of academy as congress president) Beijing,PRC,1997
93. Cochairman and member of organizing committee, VIII International Symposium on Blood Substitutes, San Diego, 2000
94. Honorary Chairman, International Society for Artificial Cells, Blood Subsitutes & Immobilization Biotechnology XIV Conference on "Artificial Cells & Cells in Novel Medical Application" Istanbul, Turkey
95. Member of MRC and CIHR "Pharmaceutical Sciences" Grants Review committee. (1999-2001)
96. FRSQ & MSSS (Quebec Ministry of Health) Member of Working group on Research Priority in Transfusion Medicine (2000-2001).
97. Member, International Scientific Committee of the 13th Congress of the International Society for Artificail Organs, Osaka, Japan, 2001
98. Member, Organizing committee of Conference in Blood Substitute organized by Karolinka Institute, Stockholm, Sweden. 2002 June
99. Member, International Scientific Committee of the 13th Congress of the International Society for Artificail Organs, Washington, D.C. 2003 .June
100. Chairman and Organizer, precongress workshop on Blood Substitutes: present and future. Joint congress of International Society for Artificial Organs/American Society for Artificial Internal Organs. Washington D.C., 2003 June
101. Honorary President and Member of International Advisory Committee, IX International Symposium on Blood Substitutes, Tokyo, Japan 2003 March
102. Scientific committee and VIP guest, III International Symposium on Biotechnology and Biomedicine, Tianjin, PRC. 2004
103. Honorary President and Member of International Advisory Committee, X International Symposium on Blood Substitutes, Providence, Rhode Island 2005, June
104. Member, Scientific Board, 2nd World Congress on Regenerative Medicine, Germany
105. 2004 Olympic Summer Games, Athen. Expert consultant (blood substitutes) for the ad hoc Court of Arbitration for Sport(CAS) on doping related matters (e.g. blood

substitutes).

106. 2006 XX Olympic Winter Games, Turin. Expert consultant for the ad hoc Court of Arbitration for Sport(CAS) on doping related matters (e.g.blood substitutes).
107. 2006 March XVIII Commonwealth Games, Melbourne. Expert consultant for the ad hoc Court of Arbitration for Sport (CAS) doping related matters (e.g. blood substitutes).
108. Honorary President and Member of International Advisory Committee, XI International Symposium on Blood Substitutes, Beijing, China 2007
109. International Scientific Board, Congress of ESAO 2007 Austria
110. Founding member, International Academy of Nanomedicine 2008-
111. NATO co-director of workshop on Advance Institute of Science 2008
112. Honorary President and Member of International Advisory Committee, XII International Symposium on Blood Substitutes, Parma, Italy. 2009
113. President and member of the board, International Academy of Nanomedicine, 2009-2010
114. International Scientific Advisory Committee First World Congress of the International Academy of Nanomedicine, Hainan, China
115. International Scientific Advisory Committee 2nd World Congress of the International Academy of Nanomedicine, Antelya, Turkey
116. International Scientific Advisory Committee. 2010 International Congress on Nanotechnology, Ottawa
117. International Scientific Advisory Committee 2010 BIT 3rd Congress on Regenerative Medicine and Stem Cells, Shanghai, China.
118. International Scientific Advisory Committee BIT 1st Congress on Nanomedicine, Beijing, China, 2010
119. Honorary President and member, International Scientific Advisory Committee, 2011 XIII International Symposium on Blood Substitutes and Oxygen Carriers, Mass General, Harvard, Boston
120. International Scientific Advisory Committee 2012 3rd World Congress of the International Academy of Nanomedicine, Ankara, Turkey
121. Honorary President, International Scientific Advisory Committee 2013 XIV International Symposium on Blood Substitutes, Institute of Blood Transfusion, Chinese Academy of Medical Sciences, China