Rigoberto C. Advincula:

Multi-awarded and Distinguished Filipino Scientist Making an Impact in Polymers and Nanomaterials

by Roderick Borong Pernites*

Professor Rigoberto C. Advincula, PhD, also known as "Gobet" by his many peers and friends, is recognized internationally for his numerous and significant contributions in the field of polymers, materials, and nanotechnology. To name a few, he has contributed to the significant growth and body of research on "polymer brushes", electropolymerizable conjugated polymer networks, dendrimer macromolecules, biosurfaces, and hybrid nanomaterials. In 2005, he invented a novel approach for combining Electrochemistry (EC), Surface Plasmon Resonance Spectroscopy (SPS) and Atomic Force Microscopy (AFM) techniques in a single set-up, which provides for simultaneous and *in situ* optical, electrochemical, and surface morphological information of electrochemically deposited ultrathin polymer films. This key enabling breakthrough which is one of a kind in the world was published in the *Review of Scientific Instruments* of the American Institute of Physics [1]. A year later, he developed a sensor device for the pico-molar and real time detection of a nerve agent using an electrochemically cross-linked ultrathin dendrimer film. Briefly, a nerve agent, which includes highly toxic organophosphate compounds, is classified as a weapon of mass destruction and has been used in chemical warfare and terrorism attacks. Therefore, the sensing of the nerve agent in very low levels is highly important. This work gained wide recognition and was later funded by the National Science Foundation, USA. The details of this work were published in the journal of *Advanced Functional Materials* [2]. In 2008, his innovative research work on nanopatterning which demonstrated current sensing AFM (CS AFM) onto a nanostructured layer-by-layer (LBL) ultrathin film of pendant carbazole-modified polyelectrolytes towards the formation of a complex nanopattern called "nano-car" was highlighted as the cover page in the American Chemical Society (ACS) journal of *Macromolecules* (Figure 1) [3].

In 2010, Dr. Advincula again made high distinction in the scientific community when his work on electrochemical and electronanopatterning of carbazole peripheral dendrimers at the air-water interface was featured and made the cover page of the ACS journal of *Langmuir* [4].

He is also considered one of the leading international experts in: (1) synthesis of new functional nanomaterials capable of ordering at surfaces and interfaces, (2) application of surface-sensitive spectroscopic, microscopic, optical, and electrochemical analytical techniques to understand ordering phenomena, (3) devices and sensor applications of ultrathin films and particles, and (4) biotechnology and biomedical applications. As a result of his competence in research, Dr. Advincula's work [5] on the cross-linking of the carbazole group at the ends of the branches of a dendrimer producing unique optoelectronic properties was externally cited in the September 2008 issue of the prestigious journal *Nature Nanotechnology* [6].

Educational Background and Training

Dr. Advincula's inclination to science was evident in his early life at the Manila Science High School from where he obtained his secondary education. He then pursued a bachelor's degree in Chemistry at the University of the Philippines (UP) Diliman in 1987. For two years, he served as a university instructor at UP Institute of Chemistry. He then travelled to the United States and completed his PhD degree in Chemistry at the University of Florida (UF) Gainesville in 1994. As an exemplary graduate scholar at UF under the supervision of a distinguished professor Dr. Randolph S. Duran, he was elected to the prestigious *Phi Beta Kappa Honor Society* chapter of UF. Also,

* PhD student of Prof. R. Advincula at the University of Houston Texas, USA.

during his graduate study, he was privileged to have worked at the Institut Charles Sadron in France as a visiting scientist. A year after obtaining his PhD, he received a distinguished appointment as *Alexander Von Humboldt research fellow* at one of the world's leading institutes in polymer science at the Max Planck Institute for Polymer Research in Germany under the supervision of world-renowned scientist Prof. Wolfgang Knoll. Afterwards in 1996, he went to Stanford University to work with Prof. Curt Frank, another eminent polymer scientist, as a postdoctoral research scholar. During this period, he was also a visiting scientist at the Hewlett-Packard and IBM research centers.

Academic Career and External Positions

In 1997, at the young age of 29, Dr. Advincula began his academic career and independent research at the University of Alabama at Birmingham (UAB) as an assistant professor in the Department of Chemistry and adjunct professor in the Department of Materials Engineering and Department of Biomedical Engineering. After 4 years, he moved to the University of Houston (UH) Texas as an associate professor in chemistry. Shortly after his two years at UH, he received a joint appointment as an associate professor in the Department of Chemical and Biomolecular Engineering. Five years later, in 2007, he was rapidly promoted as a full professor at the university. His competence in both research and education was recognized by his peers at UH, electing him to be Chair of the UH Research Council in 2008.

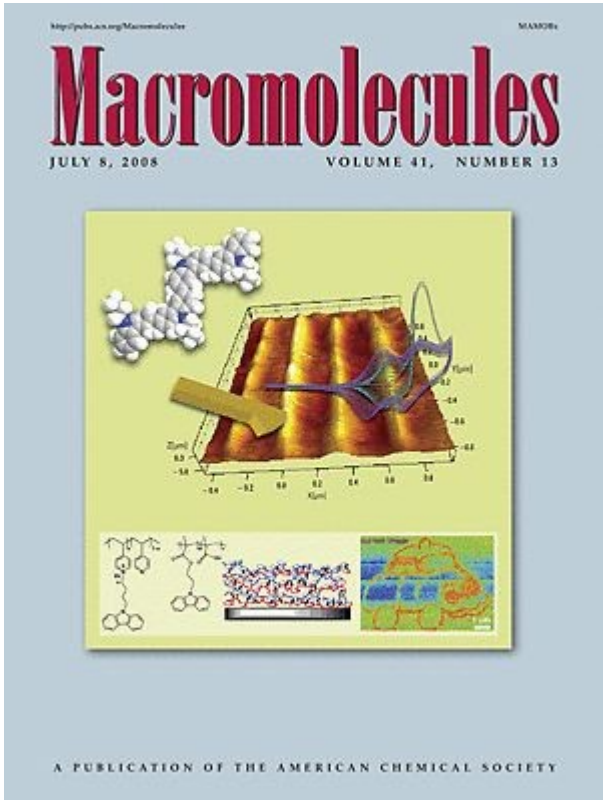

Figure 1. Cover Page of *Macromolecules* July 2008 issue highlighting the work on electronanopatterning by the Advincula Group.

Besides his various positions at UH, Dr. Advincula has served as visiting professor and/or adjunct professor to various universities abroad including the following: Austrian Institute of Technology (AIT) in 2009, University of Paris, East Paris Institute of Chemistry and Materials Science - Institut de Chimie et des Matériaux Paris-Est in 2009, Max Planck Institute (MPI) for Polymer Research in 1999, 2004, and 2006, Waseda University in 2007, McGill University in 2006, University of Montreal in 2006, National University of Singapore (NUS) Department of Chemistry in 2004 and 2006, Tokyo University of Agriculture and Technology (TUAT) Department of Organic and Polymer Materials in 2003, Venture Business Laboratory TUAT in 1997, University of the Philippines (UP) - Diliman Institute of Chemistry and Department of Chemical Engineering in 2008 and 2009, and University of Santo Tomas Department of Chemistry in 2009.

Aside from his academic positions, he also served as consultant to several companies including PPG Industries, Rhodia, Dow Corning, Exxon Mobil, Avery-Dennison Inc., Nalco Energy Services, Nanotex Inc., Roche Diagnostics, Zeon Nippon, Fuji Films, Lintec Inc., Agilent Technologies, INMAT Technologies, Dai Nippon Printing, Chemrez Technologies, San Miguel Corporation, and Kuraray America.

At present, Dr. Advincula has authored 319 publications in high impact scientific journals and has written several books and book chapters, which have been published internationally. Some of his research articles were selected as cover page of highly cited ACS journals such as Macromolecules, Langmuir, and *Journal of Physical Chemistry B*. His works are highly cited with an H-index = 33, average of 82 citations per year, average of 9 citations per article, and a total of 2,992 citations as of early 2010. He also owns 9 patents that were issued in the US.

As one of the leading experts in polymer science, he has been invited as keynote, plenary, and workshop speaker and has presented 418 times to numerous technical meetings and universities worldwide. Furthermore, he has also recently organized large scientific meetings such as the US-Japan POLYMAT 2008 of Japan Polymer Society and ACS Polymer Chemistry Division, Macromex 2008 of the Mexican Polymer Society and ACS Polymer Division, 2008 Macromolecular Assemblies for Biomolecules, Cells, and Tissues Symposium of the 236th National ACS meeting PSME Division, POLYCOM 2008 of the ACS Polymer Division, 2008 Polymer Surfaces and Interfaces of the 235th National ACS meeting PSME Division, 2008 Stimuli Responsive Polymers of the 235th National ACS meeting Polymer Division, 2007 Conjugated Polymers and Hybrid Nanomaterials of the 234th National ACS meeting Polymer Division and many more.

Aside from frequently organizing numerous technical meetings in the US and abroad, Dr. Advincula also serves as a member of the editorial and advisory boards of distinguished scientific journals such as *Macromolecules, Chemistry of*

Materials, Macromolecular Rapid Communications, Macromolecular Chemistry and Physics, Polymers for Advanced Technology, Journal of Bioactive and Compatible Polymers, Macromolecular Research. He was considered as top 10% referee to ACS journal titles and top referee proceedings in RSC journal.

Furthermore, Dr. Advincula is also a grant peer-reviewer and panelist to the following institutions in the US: National Science Foundation (NSF) - Materials, Chemistry, Engineering, MRSEC, STC, MRI, MWN, IGERT, CAREER, SBIR, STTR, National Institute of Health (NIH) – Nano Panel, SBIR Panel, Department of Energy (DOE), Department of Defense (DOD), ACS-PRF.

Research and Mentoring

Despite his many responsibilities and busy schedule, Dr. Advincula is very much involved in research, and running a research group that averages about 20 people including post-docs, PhDs, masters, and undergraduates as well as high school students (Figure 2 top) per year. His group, which is considered to be one of the largest and most highly funded (mainly by the National Science Foundation, US) at UH Department of Chemistry, consists of a team of excellent "budding" and seasoned scientists who come from different parts of the world (e.g., Europe, South America, Asia). They are actively engrossed in a number of interdisciplinary projects leading to publications and patents. Furthermore, his students are also privileged to participate in various company projects and collaborations from other research groups, namely: Prof. Curtis Frank (Stanford University), Prof. Zhenan Bao (Stanford University), Prof. Wolfgang Knoll (MPI-for Polymers and now in AIT), Prof. Pieter Stroeve (UC Davis), Prof. Jimmy Mays (Univ. of Tennessee), Prof. Jacques Le Moigne (CNRS), Prof. Hiroaki Usui (TUAT, Japan), Prof. Kiyotaka Shigehara (TUAT, Japan), Prof. Toshio Masuda (Kyoto Univ.), Prof. Futao Kaneko (Niigata Univ.), and Prof. S. Valiyaveettill (NUS). A number of his students have spent time in the laboratories of his collaborators, an "international experience" being a must as a member of his group.

Figure 2. (Top) Current members of the Advincula research group at the University of Houston-Texas. (Bottom) Prof. R. Advincula with senior Filipino PhD students (L-R) Maria Celeste Tria, Mary Jane Felipe, Nicel Estillore, and Roderick Pernites.

His laboratory holds expertise in the design, synthesis, and characterization of polymers and nanostructured materials capable of controlled-assembly, tethering, and self-organization in ultrathin films. This is comprised of functional macromolecules, coordination polymerization, polymerization on surfaces, electropolymerization, and preparation of nanoparticles and hybrid materials. His research group is also involved in investigating nanoparticles, nanostructured surfaces, and nanocomposite materials for sensor and bio-applications. Other applied studies include packaging, coatings, biomaterials, plastics, and process development. His lab is equipped with highly sophisticated and modern instruments in research for materials analysis, characterizations, and applications.

To date, Dr. Advincula has supervised over 30 graduate, 37 undergraduate and 23 high school students. He already graduated 14 PhD and 3 master students, several of them have been awarded as most outstanding graduate researcher, best teaching assistant, for best poster presentation, excellence in graduate research, etc. Like Dr. Advincula, the students who have graduated from his group are also successful in their chosen career in either academia or industry. For instance, to name a few, Dr. Derek Patton (graduated in 2006) is now an assistant professor at the University of Southern Mississippi in the School of Polymers and High Performance Materials and Dr. Jason Locklin (graduated in 2004) is also an assistant professor at the University of Georgia, Department of Chemistry. They both hold a productive research group while also mentoring undergraduate and graduate students. The rest of the recent graduates hold positions as research scientists in different leading companies and research laboratories in the US and abroad. They attribute their success to the training and supervision given by Dr. Advincula. But with utmost humility and respect, Dr. Advincula has always been quick to give back

the praise to his students and that he has been fortunate to have the best students all around, learning to "work for themselves" early on.

Distinction and Awards

As a result of his remarkable performance and achievements in research and education, Dr. Advincula has garnered numerous prestigious awards like the Arthur Doolittle award of the PSME Division of the ACS in 2003, National Science Foundation (NSF of USA) career award in 1999, and recently, Fellow of the American Chemical Society, 2010, and the Koh Science award, 2010 given by the Philippine-American Academy of Science and Engineering (PAASE). The latter is a distinction given by the Academy to outstanding members who have made significant contributions to their field and fostering Philippine-American science partnerships and contributions. At UH, he received the research excellence and scholarship award in 2007. This notable distinction is given only to selected faculty members who have achieved a substantial record of outstanding research, scholarship or creative activities in their field. He also received the Technical Focus Lecturer Award presented by the American Coatings Association in 2007. He has been nominated to the American Chemical Society's Carl Marvel Creativity Award, Mark Scholar Award, Stanley Israel Award, Alfred Sloan Foundation, and Welch Foundation's Norman Hackerman Award. Dr. Advincula was also a recipient of the 2009 Department of Science and Technology (DOST) "Balik" Scientist award and 2008 Engineering Research and Development Technology (ERDT) Fellowship of the Philippines.

Apart from his countless achievements in research, he is also an exceptional lecturer and an excellent mentor to students from high school to graduate level. As a result of his steadfast passion for education and teaching, Dr. Advincula recently received the 2010 Excellence in Undergraduate Research Mentoring award at UH. In 2007, he was considered as the Intel Science Award Finalist Mentor and was cited as *Advincula Asteroid 23017* named by the Massachusetts Institute of Technology (MIT) Lincoln Laboratory Near-Earth Asteroid Program. Dr. Advincula's inspiring and painstaking mentoring effort has enabled his students to excel and win numerous awards in both teaching and research during their stay in his group. Moreover, his students have presented their research works to national scientific meetings and have earned recognition for themselves.

Contribution to the Philippines

Like his many peers at PAASE, he has shown commitment to serve and help the Philippines in various capacities and allocation of resources. Since 1997, he regularly visits the Philippines 2 to 3 times a year while utilizing his own funds as well as UH travel funds. He has served as adjunct and visiting professor at leading universities in the Philippines such as the University of the Philippines and University of Santo Tomas. He has also shared his technical expertise by holding consultancy positions in major Philippine companies. Moreover, he has also given a number of invited talks, motivational talks, workshops, and plenary lectures to scientific meetings held in the country. This includes successful workshops in Nanotechnology (2008), Surface Analytical Methods (2009), Polymer Materials and Characterization (2009), and Polymers for Packaging, Paints, and Pharmaceuticals (2010). In 2008 he was invited as an ERDT Fellow and in 2009 as a Balik Scientist Awardee. Aside from other foreign scholars, he constantly accepts and welcomes exchange graduate and undergraduate students from the Philippines to work in his lab on their research. Presently, Dr. Advincula has several Filipino PhD graduate students at the University of Houston (Figure 2 bottom) working on their PhD degree including yours truly (from National University of Singapore), Nicel Estillore (from University of Houston), Mary Jane Felipe and Maria Celeste Tria (both from University of the Philippines-Diliman), and Katherine Puno (from Mindanao State University). A number of students through the DOST and PCHED sandwich programs are currently working in his laboratory: Lily Tiu (UP), Dahlia Apodaca (UP) and Karina Cui (UST), who will then go back to the Philippines to make their impact in polymers and nanoscience. He is constantly looking for the best and the brightest of budding scientists and engineers in the Philippines, taking them under his wings. Always ready to make the case on why Filipinos should pursue a PhD career in the sciences, he even started pitching this to the Philippine Science High School students when invited as a motivational speaker in 2009. In the future, he is looking forward to helping build a materials nanotechnology and surface analytical laboratory in the Philippines, through partnership with Faculty at the UP Institute of Chemistry and the Department of Chemistry, UST. The goal is to help the Philippines "catch up" with the rest of its Asian and Southeast Asian peers in terms of innovation and progress in materials research and nanotechnology. He is highly optimistic of the Filipino scientist. When given the tools and the resources to carry out world-class research in the Philippines or in the best laboratories abroad including his lab at UH, more talented Filipinos will shine in the international scene and contribute to world-class science!

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