BIOGRAPHICAL SKETCH

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NAME	POSITION TITLE
Moon, Joong Ho	Associate Professor
eRA COMMONS USER NAME Joong-Ho	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nurs-*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
Pusan National University, Korea	B.S.	1993	Chemistry
Pohang University of Science and Technology, Korea	M.S.	1996	Materials Chemistry
Pohang University of Science and Technology, Korea	Ph.D.	1999	Materials Chemistry
Massachusetts Institute of Technology, Cambridge, MA	Postdoctoral Fellow	1999 – 2001	Polymer Chemistry

A. Personal Statement

My research interests are to develop biomedical polymeric materials, specifically for 1) fluorescent imaging of cancers, 2) targeted delivery of therapeutic agents, and 3) monitoring of biological events.

I am a materials chemist by training with significant independent biomedical research experience before joining the FIU faculty at 2008. After finishing my postdoctoral training at MIT under Prof. Timothy Swager, who is a pioneer in the field of conjugated polymers (CPs) for ultrasensitive detection of chemical and biological interests, I joined a company as a principal investigator to develop highly sensitive biosensors for nucleic acids, proteins, bacteria, and pathogens detection.

My research at FIU has focused on the design and synthesis of new π-electron conjugated materials for biological and biomedical applications. My group has developed novel synthetic and fabrication methods for CPs and conjugated polymer nanoparticles (CPNs) and used the polymeric materials for cellular imaging and small interfering RNA (siRNA) delivery applications. We have investigated the relationship between the chemical properties of the CPNs and their biological functions to further improve cellular labeling and delivery efficiency.

Currently I am conducting a project to develop multiphoton polymer probes for sensitive and specific cancer labeling. By modulating self-assembly processes of biodegradable CPs, I am also developing efficient dene/drug delivery nanoparticles under support from NSF CAREER award.

Because the nature of my research projects is highly interdisciplinary, I have very strong collaboration components on my research activities. I also served as students' PhD committee from chemistry, physics, biomedical engineering, materials engineering, and electric engineering.

I have a long and steady record of student support and mentoring. Currently I have two doctoral students, three undergraduate students, and two postdoctoral fellows (will join in Oct and Nov 2016) working on the projects mentioned above. Two graduate students successfully defended this year. I am a co-advisor of the FIU Chem club. As an outreach activity under the NSF award, we were able to invite total ~200 high school students (mostly underrepresented minority) from local community to offer one-day college experience including facility tour, attending a lecture, and conducting an experiment at the Department of Chemistry and Biochemistry. The ultimate goal of the outreach program is to contribute to increase the number of minority in STEM by offering early college-level science experience.

Overall, I have active research program for developing new multifunctional biomaterials for disease therapeutics and am enthusiastic on the minority education with a solid track record for minority training.

B. Positions and Honors

1999 – 2001 Postdoctoral Associate, MIT, Cambridge, MA

2001 – 2008 Principal Investigator, Research Chemist, ICx Technologies, Inc., Cambridge, MA

2004 – 2008 Visiting Scientist, Institute for Soldier Nanotechnologies, Massachusetts Institute of Technology (MIT), Cambridge, MA

2008 – 2014 Assistant Professor, Department of Chemistry and Biochemistry, Florida International University, Miami, FL

2014 – present Associate Professor, Department of Chemistry and Biochemistry, Florida International University, Miami, FL

Honors

2015 FIU Top Scholar
2014 NSF CAREER Award
1999 Korean Science and Engineering Foundation Postdoctoral Fellow
1999 Outstanding Research (Pohang Advanced Light Source)

C. Contribution to Science

As a materials/organic chemist, my research at FIU has focused on the design and synthesis of new π-electron conjugated materials for biological and biomedical applications. My group has developed novel synthetic and fabrication methods for conjugated polymers (CPs) and conjugated polymer nanoparticles (CPNs) and used the polymeric materials for cellular imaging, drug/nucleic acid delivery, and biosensing applications. We have investigated the relationship between the chemical/physical properties of the CPNs and their biological functions to further improve cellular labeling, delivery, and sending efficiency.

Fluorescent tissue imaging

CPN's high brightness, photostability, and nontoxicity are promising properties for live cell/tissue imaging. We are interested in developing CP-based biomaterials for tumor specific imaging by functionalizing CPs with targeting ligands. Collaborating with Prof. Peter So at MIT, we demonstrated that CPNs are extremely bright and stable two-photon (2P) materials exhibiting nontoxicity. Using a tissue culture model, we imaged endothelial cell growth up to three days without observing any toxic effects (*Adv. Mater.* 2009). By complexing CPNs with cancer cell specific hyaluronic acid (HA), we demonstrated cancer cell specific labeling with low binding to normal cells (*Macromolecules* 2013). We are synthesizing biodegradable CPN/HA hybrid materials for in vivo tumor labeling.

1. **J. H. Moon***, William McDaniel, Paul MacLean and L. F. Hancock, "Live cell permeable poly(p-phenylene ethynylene)", *Angew. Chem. Int. Ed.*, 46, 8223-8225 (**2007**).
2. A. Abdul Rahim, W. McDaniel, K. Bardon, S. Srinivasan, V. Vickerman, P. T. C. So, *and* **J. H. Moon***, "Conjugated Polymer Nanoparticles for Two-photon Imaging of Endothelial Cells in a Tissue Model", *Adv. Mater*. *21*, 3492-3496 (**2009**).
3. "Fabrication of core-shell nanoparticles via controlled aggregation of semiflexible conjugated polymer and hyaluronic acid", M. Twomey, Y. Na, Z. Roche, E. Mendez, N. Panday, J. He, **J. H. Moon,*** *Macromolecules*, 46, 6374-6378 (**2013**).
4. "Mitochondria-specific conjugated polymer nanoparticles", M. Twomey, E. Mendez, R. Manian, S. Lee*, and **J. H. Moon***, *Chemical Communications*, 52, 4910–4913 (**2016)** (DOI: 10.1039/C6CC00810K)

Developing novel biomaterials for therapeutic delivery

Cellular entry pathways of nanomaterials influence overall delivery efficiency. We are interested in understanding and modulating cellular behaviors of CPNs by changing chemical properties of CPs. Cellular entry pathways, trafficking, and toxicity of carriers significantly impact overall gene/drug delivery efficiency. The goal is to understand how the chemical and physical properties of the CP/gene/drug complex influence cellular behaviors and to demonstrate the improved efficacy. Our approaches to improve the overall efficiency are to 1) increase cellular entry, 2) deliver the payloads to target organelles, and 3) increase the release of the payloads from the cargo. The preliminary data suggests that further fine-tuning of the chemical and physical properties of CPN/nucleic acids complex (i.e., polyplexes) can be accomplished by changing backbone lengths, backbone compositions, and types of polyanions. Biodegradability of the complex will provide optimized drug release depending on the complex's structures and subcellular localizations. Tailoring the carriers' properties to

modulate cellular interaction and entry will have high impact on the gene and drug delivery. For the first time, we used CPNs for siRNA delivery to knock down target genes in both plant (*BMC Plant Biol*., 2010) and animal (*Chem. Comm.*, 2011) cells. By monitoring cellular uptake efficiency and immunostaining against caveolin-1 (a protein found in caveosomes), we found that CPNs use caveolae-mediated endocytosis, which is one of the least destructive endocytosis pathways (*Macromol. Biosci.*, 2013). We also found that a subtle change in the side chain and backbone affects subcellular localization. CPNs fabricated from non-ethylene oxide containing, semi-flexible CPs exhibit high Golgi localization (*Chem. Comm.*, 2013).

1. **J. H. Moon**,***** E. Mendez, Y. Kim, A. Kaur, "Conjugated Polymer Nanoparticles for Small Interfering RNA Delivery", Chem. Comm. **47, 8370 (2011)**
2. Side chain and backbone structure-dependent cellular toxicity and subcellular localizations of conjugated polymer nanoparticles", E. Mendez and **J. H. Moon,*** *Chem. Comm.* **49 (54), 6048 (2013)**
3. Cavelolae-mediated endocytosis of conjugated polymer nanoparticles", J. Lee, M. Twomey, C. Machado, G. Gomez, M. Doshi, A. J. Gesquiere, **J. H. Moon***, *Macromolecular Bioscience*, 13, 913 (**2013**)
4. "Scanning ion conductance microscopic study for cellular uptake of cationic conjugated polymer nanoparticles", Y. Shan, N. Panday, Y. Myoung, M. Twomey, X. Wang, W. Li, E. Celik, V. Moy, H. Wang*, **J. H. Moon***, J. He*, *Macromolecular Bioscience*, in print (**2016)** (DOI: 10.1002/mabi.201500320)

Highly sensitive biological/biomedical sensors

Changes in urinary glycosaminoglycan (GAG) levels can signify proliferation of several diseases including kidney and bladder disorders, polysaccharide storage diseases, and certain cancers. Using excellent emission properties of CPs, we are developing highly sensitive biological/biomedical sensors. Depending on the aqueous solubility of CPs and the nature of interaction between CPs and analytes, structural changes can occur in individual CP chains or multiple chain aggregates, which correspond to changes in CP optical properties. The key idea is to use the structural integrity of CPNs in a real biological fluid (i.e., undiluted serum, urine, or saliva) and the structural reorganization of CPs under the polyelectrolyte interaction accompanying sensitive optical changes. Novel synthetic methods of controlling aggregations were developed to control the self-assembly processes. We have used four different CPNs that act as both an analyte receptor and a signal transducer, and analyze their differential responses to each GAG in a urine simulant.

1. Y-J. Ko, E. Mendez, **J. H. Moon**,* "Controlled aggregation of conjugated polymer nanoparticles via organic acid treatments", *Macromolecules*, 44, 5527 (**2011**)
2. "Synthesis of phenyleneethynylene-doped poly(phenylenebutadiynylene)s for live cell imaging" T. Vokata, **J. H. Moon***, *Macromolecules*, 46, 1253 (**2013**)
3. "Synthesis of Biodegradable Conjugated Polymers with Controlled Backbone Flexibility", T. Vokatá, M. Twomey, E. Mendez, **J. H. Moon***, *J. Poly. Sci., Part A. Poly. Chem.*, 53, 1403–1412 (**2015**)
4. "Differential interactions of conjugated polymer nanoparticles with glycosaminoglycans in synthetic urine", M. Twomey, T. Vokatá, M. R. Kumar and **J. H. Moon***, *Chem. Commun.* 51, 4065-4068 (**2015**)

Complete List of Published Work in My Bibliography
http://www.ncbi.nlm.nih.gov/sites/myncbi/joong ho.moon.1/bibliography/44027257/public/?sort=date&direction=descending

D. Research Support

Ongoing Research Support

NSF CAREER DMR-1352317 Moon (PI) 9/1/14-8/31/19
Self-assembled biodegradable conjugated polymers for RNA interference:
Development of efficient gene delivery materials using self-assembly of conjugated polymers

Korea Evaluation Institute of Industrial Technology Moon (PI at FIU) 9/1/14-8/31/19
Development of 35% lightweight CCB module for automotive using highly impregnated nylon based LFT composites:International collaboration for developing engineered plastics for automobiles.

Completed Research Support

SC1 GM092778-01A1 Moon (PI) 8/1/11-7/31/15
Title: Multiphoton probes for biomedical imaging:
Development of highly bright conjugated polymer nanoparticles as multiphoton cancer probes

1 R15 CA167571-01A1 McGoron (PI) 8/1/13 – 8/31/16
Title: Novel Polymeric nanoparticles for drug delivery applications
The objective of this proposal is to develop a new polymeric drug carrier combining imaging and chemo-therapy with triggered and controlled release of chemotherapeutic drug and subsequent degradation of polymer vehicle.