
BK4
Kick-off Mt
2021.02.22 (Mon) 11:00 a.m.
SGU
ChBE BK21
Center for Molecular-scale Control in
Chemical and Biological Engineering
SOGANG
UNIVERSITY
Zoom link
https://us02web.zoom.us/j/89736787109?
ID: 897 3678 7109 / PW: 750082

Greetings!
Prof. Jeong-Woo Choi (Dean of College of Engineering)

SGU ChBE BK21 Kick-off Meeting

2021. 2 22 (Mon) 11:00 a.m. Seoul
Zoom https://us02web.zoom.us/j/89736787109 (ID: 897 3678 7109/ PW: 750082)

10:45 – 11:00 Registration
11:00 – 11:10 Opening remarks by Prof. Jeong-Woo Choi (Dean of College of Engineering)

11:10 – 11:30 Jeong-Woo Choi "Nanometal-based bioactuator with enhanced actuation performance for biohybrid robot"

11:30 – 11:50 Moon Sung Kang "High-resolution Patterning of Colloidal Quantum Dots via Light-driven Ligand Crosslinking"

11:50 – 12:10 Break

12:10 – 12:30 Jun Hyuk Moon "Complete Encapsulation of Sulfur in Porous Carbon: A Key Process for High-performance Lithium-sulfur Batteries "

12:30 – 12:50 Hyuncheol Kim "Phospholipid-based Nanordill Technology for Enhanced Intracellular Uptake of Drug Delivery Systems "

12:50 – 13:10 Jong Suk Lee "Tailoring structures of molecular sieve membranes for gas separations: opportunities and challenges"

13:10 – 13:30 Discussion

13:30 – 13:40 Closing remarks by Prof. Jong Suk Lee

Sponsors: BK21four program, Department of Chemical and Biomolecular Engineering, Sogang University

*For questions regarding the Kickoff program, contact Prof. Jong Suk Lee (*jongslee@sogang.ac.kr*)

Nanometal-based bioactuator with enhanced actuation performance for biohybrid robot

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Biohybrid robot has been developed due to its application possibility to the industrial robot and medical robot. The enhancement of bioactuator force has been needed since up to now the movement of biohybrid robot by bioactuator is too weak for the real applications. In this study, to increase the performance, MoS_2 nanosheet based biohybrid actuator and hyaluronic acid-gold nanoparticle (HA-AuNPs) based biohybrid actuator were developed for biohybrid robot. Bioactuator composed of muscle cells/MoS_2 nanosheet showed high actuation performance since MoS_2 nanosheet augmented the motion of muscle cells. And HA-AuNPs were incorporated with a muscle cell bundle to construct the bioactuator used to fabricate the simple biohybrid robot with linear movement by electrical stimulation. HA-AuNPs enhanced the actuation performance of the muscle cell bundle, which increased the movement speed of the biohybrid robot. These proposed bioactuators can be applied to construct the biohybrid robot with motion control by sensing function. Acknowledgments: This research was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No.2019R1A2C3002300)

References

[1] S.J. Park, J.-W. Choi, K.K. Parker* and et al., *Science*, **2016**, 353, 158-162.

[2] J.H. Choi, J.-W. Choi*, **2020**, Nano Letters, 20, 7100-7107.

High-resolution Patterning of Colloidal Quantum Dots via Light-driven Ligand Crosslinking

Moon Sung Kang[1]

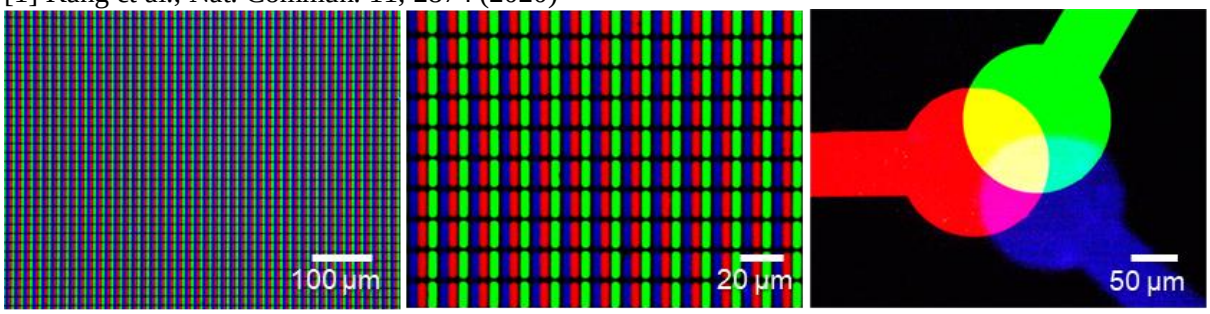
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To fully exploit the excellent luminescence characteristics of quantum dots (QDs), researches on EL displays based on QDs have been actively conducted. To achieve this, a multi-color QD patterning technology must be established. Processing and patterning of quantum dots involve a solution-based technique, unlike the organic light emitting materials which are typically deposited through evaporation-based technique. The applicability of QDs to various solution process allows one to carry out their deposition over a large-scale at low cost, but it also causes a problem of dissolving the bottom layer if the secondary layer is applied by solution process consecutively. Here we report a simple way to obtain high-resolution patterns of QDs using a chemical crosslinker (bis-perfluorophenyl azide) that can bind to ligands surrounding the QD surface to form a bridging network upon exposure to UV, which is referred to as the light-driven ligand crosslinker (LiXer).[1] Due to the chemical durability of the cross-linked QDs, non-crosslinked portions can be etched chemically to form high resolution (<3 μm) patterns of QDs. Multi-color patterns can also be stacked laterally or vertically by repeating the same solution process. The EL characteristics of the cross-linked QDs varied systematically with the loading of the LiXer. The optimal loading of the LiXer yielded the cross-linked QDs with EL characteristics comparable to those of pristine QDs. The simple strategy converting the QD films to be photo-resistive will make significant impact enabling the production of high-resolution, high-throughput, full-color EL displays based on QDs intensively explored in the community.

References

[1] Kang et al., Nat. Commun. 11, 2874 (2020)



Complete Encapsulation of Sulfur in Porous Carbon: A Key Process for High-performance Lithium-sulfur Batteries

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Lithium-sulfur batteries rely on the reaction of sulfur to lithium sulfide or vice versa. For the cathode of a lithium-sulfur battery, it is highly required to completely contain sulfur in the porous carbon. This is to minimize the loss of lithium polysulfide due to its high solubility in the electrolyte. However, the relatively low affinity between sulfur and carbon makes it difficult for sulfur to penetrate completely into the porous structure of carbon, so a strategy is needed. As a way to tackle this, we suggest engineering a porous structure. By using a polymer colloid sacrificial template, pores are formed in the spherical CNT assembly, which improves the capillary action. In addition, we introduce the control of the interfacial energy of a solution containing sulfur. This is obtained by adding a solution having high compatibility with carbon
to the sulfur-solution. Finally, we present the coating of metal compound nanoparticles with chemical affinity with sulfur on the carbon surface. The complete and uniform encapsulation of sulfur by each of these methods immediately improves the performance of the lithium-sulfur battery; we analyze the influence of the sulfur loading on the electrochemical reaction

Phospholipid-based Nanordill Technology for Enhanced Intracellular Uptake of Drug Delivery Systems

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Drug delivery system including nanoparticles are under active development but most of the nanoparticles enter the cell via endocytosis. However, a significant amount of the endocytosed cargo are not able to escape from the endosome, resulting in endosomal entrapment and lysosomal degradation of the drugs. Due to several barriers into intracellular delivery, circumventing the endocytic pathway is desirable. Thus, in recent years, several attempts have been made to develop transmembrane delivery systems such as cell penetrating peptide (CPP)-conjugated nanoparticles rather than endocytosis. However, CPP is known to be degraded and inactivated by serum proteases in *in vivo*. To overcome the limitations associated with peptides such as CPP, we have developed phospholipid-based nanodrill technology on the surface of nanoparticles (LD-NPs) via self-assembly of phospholipids for enhancing intracellular delivery of nanoparticles. LD-NPs penetrate the cells via energy-independent penetration through the membrane, unlike other nanoparticles. The potential of LD-NPs in drug delivery was confirmed through *in vitro* and *in vivo* experiments, such as gene therapy via siRNA delivery and chemotherapy to drug resistance cells.

References

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Tailoring structures of molecular sieve membranes for gas separations: opportunities and challenges

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Membrane-based gas separations, the pressure-driven separation process can be an order of magnitude more energy efficient than the distillation-based counterparts, the thermally-driven process [1]. Especially, the separation of condensable gases including natural gas sweetening and olefin/paraffin separation is an attractive membrane market. Unfortunately, polymeric membranes are suffering from the limited separation performance due to a trade-off between permeability and selectivity. Also, they are susceptible to condensable gas-induced plasticization at high feed pressure, resulting in undesirable selectivity loss. In this talk, I will present our rational strategies of engineering structures of molecular sieve membranes for gas separation applications. Our group reported on the excellent C_3H_6/C_3H_8 separation performance of mixed matrix membranes by engineering the pore size of zeolitic imidazolate frameworks (ZIFs) [2, 3]. Different combinations of metal-ligand in ZIF molecular sieves enable fine tuning of pore structures, attaining the excellent C_3H_6/C_3H_8 separation performance. Carbon molecular sieve (CMS) membranes are another attractive molecular sieve membrane for gas separation applications. We demonstrated CMS hollow fiber membranes with high CO_2/CH_4 separation performance and good plasticization resistance by pyrolyzing newly designed blending precursors of polyimide/ladder-structured polyseilsequioxane (PI/LPSQ) [4]. The homogeneous blending of PI and LPSQ effectively suppressed the thermal stress-induced sub-structure collapse due to the enhanced chain rigidification of PI side chains, resulting in high CO_2 flux with good CO_2/CH_4 separation efficiency. With that, the effect of SiOx phases in PI/LPSQ CMS membranes on C_3H_6/C_3H_8 or N_2/CH_4 separations was investigated [5, 6].

References

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[2] An, H.‡; Park, S.‡; Kwon, H.T.; Jeong, H.-K.; Lee, J.S.*, *J. Membr. Sci.*, **2017**, 526, 367-376.

[3] Oh, J.W.‡; Cho, K.Y.‡; Kan, M.-Y.‡; Yu, H.J.; Kang, D.-Y.*; Lee, J.S.*, *J. Membr. Sci.*, **2020**, 596, 117735-117744.

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