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ADVANCED OPTOELECTRONIC MATERIALS AND DEVICES VIA INTEGRATING FUNCTIONAL POLYMERS

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In this presentation, we introduce our recent accomplishments on the integration of tailor-designed polymers for diverse applications. Hybrid plasmonic nanostructures comprising Au nanoparticle arrays separated from Au substrate through a temperature-sensitive poly(N-isopropylacrylamide) linker layer were constructed, and a unique plasmonic-coupling-based surface plasmon resonance sensing properties and visible light active photocatalysis were investigated. Multimetallic Core@Shell nanoparticles consisting of Au core and metal-containing polyaniline shells were prepared and their bifunctional electrocatalytic performance was systematically investigated. Well-defined ordered arrays of plasmonic nanostructures were fabricated on stretchable poly(dimethyl siloxane) substrates and tunable plasmon-coupling-based sensing properties were comprehensively demonstrated upon extension and contraction. We studied phosphorescence emission enhancement of a purely organic phosphor system via plasmon resonance energy transfer by precisely tuning the distance between purely organic phosphor crystals and plasmonic nanostructures using layer-by-layer assembled polyelectrolyte multilayers as a dielectric spacer. We demonstrate a viable laser interference lithography technique enabling the development of high-performance plasmonic organic photovoltaic (OPV) devices. Ag nanodot arrays with optimized configuration embedded in poly(3,4-ethylenedioxythiophene):poly(styre-esulfonate) hole transport layer remarkably enhanced the average power conversion efficiency by ~34.4% compared to the pristine device. Hierarchically organized porous carbonized-Co_3O_4 inverse opal nanostructures were synthesized via complementary colloid and block copolymer self-assembly, where the triblock copolymer Pluronic P123 acts as the template and the carbon source. These highly ordered porous inverse opal nanostructures with high surface area display synergistic properties of high energy density and promising bifunctional electrocatalytic activity toward both the oxygen reduction reaction and oxygen evolution reaction in Li-air battery.

Recent Publications:

1. Seol A Cho, Yu Jin Jang, Hee-Dae Lim, Ji Eun Lee, Yoon Hee Jang, *et al.* (2017) Hierarchical porous carbonized Co_3O_4 inverse opals via combined block copolymer and colloid templating as multifunctional electrocatalysts and cathodes in Li-O_2 battery. Adv. Energy Mater DOI: 10.1002/aenm.201700391.
2. Ji-Eun Lee, Yu Jin Jang, Wenqian Xu, Zhenxing Feng, Hee-Young Park, *et al.* (2017) PtFe catalysts supported on electroactive Au-PANI Core@Shell nanoparticles for high-performance electrocatalysis. J. Mater. Chem. A 5:13692–13699.
3. Yulin Oh, Ju Won Lim, Byung-Hyun Kang, Young Wook Park, Heejun Kim, *et al.* (2016) Plasmonic periodic nanodot arrays via laser interference lithography for organic photovoltaic cells with >10% efficiency. ACS Nano 10(11):10143–10151.
4. Ji-Eun Lee, Jumi Lee, Kyungwha Chung, Kwanwoo Shin, Dong Ha Kim, *et al.* (2015) *In situ* studies of surface plasmon resonance coupling sensor mediated by stimuli-sensitive polymer linker. Adv. Funct. Mater. 25(18):6716–6724.
5. Minji Yoon, Ji-Eun Lee, Ju Won Lim, Saji Thomas Kochuveedu, Yu Jin Jang, *et al.* (2015) Comprehensive study on the controlled plasmon-enhanced photocatalytic activity of hybrid Au/ZnO systems mediated by thermoresponsive polymer linkers. ACS Appl. Mater. Interf. 7(38):21073–21081.

Biography

Dong Ha Kim is currently a Full Professor and Ewha Fellow in the Department of Chemistry and Nano Science of School of Natural Sciences at Ewha Woman's University and Fellow of the Royal Society of Chemistry. He has authored 145 SCI publications and holds 29 registered Korean and two US patents. He is serving as Associate Editor of Science of Advanced Materials (American Scientific Publishers), Editorial Board Member of Scientific Reports (Nature Publishing Groups) and Advisory Board Member of Nanoscale and J. Mater. Chem. (Royal Society of Chemistry). His research interests include development of multi-functional hybrid nanostructures for applications in energy storage and conversion, environmental remediation, memory devices, display devices, and biomedical diagnosis/therapy, surface plasmon resonance mediated theranostics, optoelectronics, photocatalysis and light emission.

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