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Scattering and plasmonic phenomena of nanoparticle self-assembled arrays in the thin-film organic lighting devices and photovoltaics

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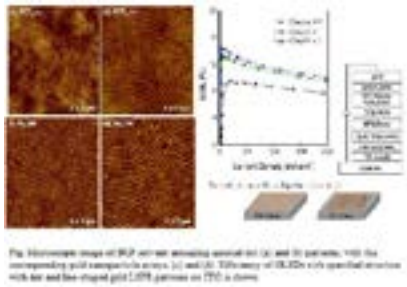
The approach using localized surface plasmon resonance (LSPR) from metallic nanoparticles is attractive as one of the promising method to enhance the internal quantum efficiency of an organic light emitting diode (OLED) or power conversion efficiency of an organic solar cell (OSC), where the various shapes and geometrical arrangements of the nanoparticle and the nanostructures affects their performances. LSPR increases electromagnetic density of states which contribute to more efficient light emission of OLEDs. In order to investigate the light extraction from metallic nanoparticle array, we have compared the monodispersed silver nanoparticles (randomly dispersed onto substrates by spin-coating) with the ordered gold metallic arrays (formed by the phase separation of block copolymer; BCP). Gold nanoparticles arrays were given a particular morphology, which is driven by self-assembly of polystyrene-block-poly (2-vinyl pyridine) BCP thin film by solvent-annealing process. Controlling the annealing time and solvent type of the block copolymer results in the various nano-morphologies. In case of OLED, light emission efficiency (internal quantum yield) shows notable improvement (about 43.8%) in terms of current efficiency for line patterns of Au nanoparticles array developed by BCP self-assembly. Those plasmonic nanostructures of gold were almost similar scales of BCP patterns, formed at the on the surface of anode (ITO) at both OLED and OSC, showing notable enhancements of the light extraction and power conversion efficiency. The size and the anisotropy of gold nano-patterns were changed from a simple dispersion of dot through an integrated dot-line pattern, finally to a contour line pattern with higher percolation of particle array.



Biography

Prof. Ohyoung Kim has expertise in biomedical polymer, environmental-friendly polymer as well as various functional nanomaterials and polymers for electronic application. He received his B.S. and M.S. degree at Seoul National Univ., and Ph.D. degree from Univ. of Massachusetts at Lowell (polymer science). From 1997, he has been served as a professor at department of polymer science and engineering, Dankook University, Gyeonggi, Korea, with special contributions as a head of industry-university cooperation foundation, office of planning, and secretary's office of President of Dankook University. He is currently a dean of faculty for college of engineering and graduate school of information technology & intellectual property.

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