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Bioinspired multi-functional surface-relief nanostructures for optical and optoelectronic device applications

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Abstract

Recently, bioinspired nanostructures which resemble nature materials with hierarchical structures have attracted considerable attention because of their potential applications such as light-emitting diodes, photovoltaic devices, displays, and optical sensors. For example, subwavelength grating structures inspired from the moth-eye corneas have a period smaller than the wavelength of incoming light, which leads to a superior antireflective property. Three-dimensional (3D) hierarchical micro-/nanostructures engineered by integrating 1D nanostructure into 2D template allow the possibility for a multi-functions application. Additionally, these structures can modify the physical and optical properties. The hierarchical structures can be formed in a variety of shapes including flakes, flowers, urchins, etc. because the large surface area to volume ratio and the quantum size effect are very crucial for improving the efficiency of devices. The light scattering for enhanced photon absorption can be promoted by the hierarchical structures. In this talk, I present the fabrication and characteristics of bioinspired multi-functional nanostructures, with the aid of theoretical analysis. The surface-relief nanostructures were fabricated by various nano-patterning methods including thermal dewetting, laser interference lithography, and spin coating/dip coating of spheres for etch masks. Optical transmittance of substrate was also improved by introducing the subwavelength structures into its surface. These results may provide a deep insight into morphologies and optical properties of the hierarchical semiconductor nanostructures for optical and optoelectronic device applications.

Biography

Jae Su Yu received the Ph.D. degree in optoelectronic engineering from Gwangju Institute of Science and Technology, Republic of Korea, in 2002. He joined the Center for Quantum Devices, Northwestern University, Evanston, IL, as a Postdoctorial Fellow in Oct. 2002, where he worked on the fabrication, packaging, and characterization of quantum cascade lasers. Since joining in Sept. 2006, he is a Tenured Associate Professor in the Department of Electronic and Radio Engineering, Director of the Institute for Laser Engineering, and Kyung Hee Fellow, Kyung Hee University, Republic of Korea. He has authored or co-authored more than 170 journal papers. His research interests include solar cells, light-emitting diodes, optical sensors, nanostructures, nanophotonics, etc.