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Nanoparticles In Liquid Crystals

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Abstract:

Tunable composite materials with novel physical behavior can be designed through integrating unique optical properties of solid nanostructures with the facile responses of soft matter to weak external stimuli, but this approach remains challenged by their poorly controlled co-assembly at the mesoscale. Using scalable wet chemical synthesis procedures, we fabricated anisotropic photon-upconverting, plasmonic, and gold-silica-dye colloidal nanostructures and then organized them into the device-scale electrically tunable composites by simultaneously invoking molecular and colloidal self-assembly [1-4]. We show that the ensuing ordered colloidal dispersions of shape-anisotropic nanostructures exhibit tunable properties, such as the fluorescence decay rates and emission intensity. We characterize how these properties depend on low-voltage fields and polarization of both the excitation and emission light, demonstrating a great potential for the practical realization of an interesting breed of nanostructured photonic composites.

[1] H. Mundoor, B. Senyuk, and I. I. Smalyukh. Science 352, 69-73 (2016).
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[3] Y. Zhang, Q. Liu, H. Mundoor, Y. Yuan, I. I. Smalyukh. ACS Nano 9, 3097-3108 (2015).
[4] H. Mundoor and I. I. Smalyukh. Small 11, 5572–5580 (2015).

Bio

Ivan I. Smalyukh is an Associate Professor at the Department of Physics, University of Colorado, Boulder. He is also a founding fellow of the Renewable and Sustainable Energy Institute (RASEI), Join Institute of the National Renewable Energy Laboratory (NREL) and University of Colorado, as well as a Fellow of the Materials Science and Engineering Program at CU-Boulder. At CU, he is heading a soft condensed matter research group with 30 group members (students and postdocs) and with a broad spectrum of research interests, ranging from topology to self-assembly, from naoscience to renewable energy research, and from nanophotonics to the development of new optical imaging and manipulation techniques. Smalyukh's recent awards and honors include 2015 GSoft Award, 2014 Bessel Award, 2013 DOE Early Career Research Award, 2011 Kavli Frontiers Fellowship, 2010 Presidential Early Career Award for Scientists and Engineers (PECASE) from the Office of Science and Technology Policy of the White House, 2010 Sigma Pi Sigma Favorite Professor recognition, 2009 NSF CAREER Award, 2006 Glenn H. Brown Prize, and many other. Professor Smalyukh published over 140 peer-reviewed research articles in top international journals such as Nature, Science, PNAS, etc. Smalyukh is on editorial boards of two international journals and organized a large number of conferences, workshops, and summer schools.