Printing Grayscale and Multiscale Metasurfaces using Nanoscale Capillary Effect and Triboelectricity

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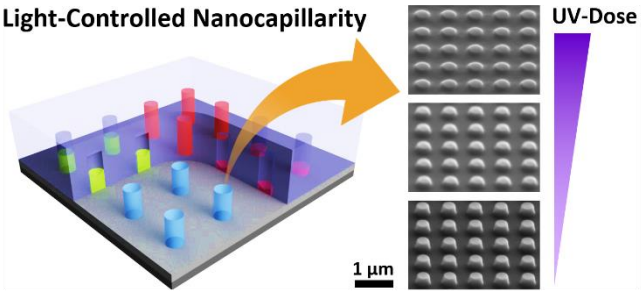

Abstract

As arrays of nanopixels, metasurfaces play increasingly important roles in modern technology. Recent studies revealed that their functionalities can be further enhanced by spatially modulating the height of the nanopixels. Realizing the concept, however, is very challenging since it requires “grayscale” printing of the nanopixels in which their height is controlled within a few nanometers as a micrometric function of position. This talk describes one such technique for grayscale printing of polymeric nanopixels at high vertical and lateral resolutions. The enabling factor was the little-known fact that the capillary rise of certain photopolymers can be controlled by light, to stop at a predetermined height with sub-10-nm accuracy. Microscale spatial patterning of the control light directly upgrades the height-modulation into a “2.5D” printing of nanopixels. Its utility is verified through readily reconfigurable, maskless printing of grayscale dielectric and metallo-dielectric nanopixel arrays. This talk will also discuss the use of nanoscale triboelectric effect for metasurface printing, expanding its implementation and application scopes.

Bio

Professor Jay Kim received his Ph.D. degree in Electrical Engineering in 2003 from the University of Michigan (Ann Arbor) with research on nonlinear optics and integrated optics. Then, he joined Berkeley Sensor & Actuator Center (BSAC) at the University of California (Berkeley) as a postdoctoral fellow, studying bio-inspired optics and plasmonics. In 2006, he joined the Electrical & Computer Engineering Department of Iowa State University, where he is currently a Professor and the Director of Graduate Education. His current research focuses on bio-inspired optics, soft material MEMS and NEMS, nanofabrication of optical devices. Prof. Kim is the recipient of the National Science Foundation (NSF)’s CAREER Award and Air Force Summer Faculty Fellowship. He also received Warren B. Boast Undergraduate Teaching Award and Harpole-Pentair Developing Faculty Award.