Device Applications of Metafilms and Metasurfaces

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Many conventional optoelectronic devices consist of thin, stacked films of metals and semiconductors. In this presentation, I will demonstrate how one can improve the performance of such devices by nano-patterning the constituent layers at length scales below the wavelength of light. The resulting metafilms and metasurfaces offer opportunities to dramatically modify the optical transmission, absorption, reflection, and refraction properties of devices. This is accomplished by encoding the optical response of nanoscale resonant building blocks into the effective properties of the films and surfaces. To illustrate these points, I will show how nanopatterned metal and semiconductor layers can be used to enhance the performance of photodetectors, solar cells, and enable new imaging technologies.

Figure 1: Colorful flower constructed from subwavelength Si nanobeams spaced at subwavelength spacings. The left panel shows a darkfield optical image of a the flower under white light illumination. The different structural colors (blue, green yellow, and red) seen in the image are the product of the different beam sizes in areas 1, 2, 3, and 4. The different beam sizes support optical scattering resonances that critically depend on the beam size and cross sectional shape.

References