Assembly of 2D Metafilms into 3D Optoelectronic Devices.

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Many conventional optoelectronic devices are comprised of thin, stacked films of metals, semiconductors, and insulators. In this presentation, I will demonstrate how one can improve the performance of such devices by nano-structuring the constituent layers at length-scales below the wavelength of light. The resulting nanostructures have unique optical responses that depend on their size, shape, and orientation. We can encode these responses into the effective optical properties of the films and surfaces. This can lead to a dramatic modification of their optical transmission, absorption, reflection, and refraction properties. By integrating these high-performance meta-layers with conventional optical and electronic elements there are opportunities to realize new functions and to achieve notable reductions in the materials and assembly costs of complex 3D optical systems.

To illustrate these points, I will show how nanopatterned metal and semiconductor layers may be used to enhance the performance of solar cells, displays, and enable new imaging technologies. Conventional semiconductor device fabrication tools can be used, but new approaches such as nano-imprint and rolling lithography may be required in many applications to allow patterning across large areas at low cost.

Biosketch

Mark Brongersma is the Stephen Harris Professor in the Departments of Materials Science and Applied Physics at Stanford University. He leads a research team of ten students and five postdocs. Their research is directed towards the development and physical analysis of new materials and structures that find use in nanoscale electronic and photonic devices. He is on the list of Global Highly Cited Researchers (Clarivate Analytics). He received a National Science Foundation Career Award, the Walter J. Gores Award for Excellence in Teaching, the International Raymond and Beverly Sackler Prize in the Physical Sciences (Physics) for his work on plasmonics, and is a Fellow of the OSA, the SPIE, and the APS. Dr. Brongersma received his PhD from the FOM Institute AMOLF in Amsterdam, The Netherlands, in 1998. From 1998-2001 he was a postdoctoral research fellow at the California Institute of Technology.