**Extreme Nano-Optics Enabled by Ultrasmooth Metals and ALD Technologies**

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Plasmonic devices can beat the diffraction limit and confine electromagnetic waves into nanometer-scale gaps. Precise and high-throughput fabrication of such extreme nanophotonic structures is challenging with even the most advanced electron-beam lithography tool. I will present unconventional approaches to produce ultranarrow plasmonic gaps by leveraging mature silicon processing technologies.

Template stripping [1] has enabled rapid production of atomically smooth patterned metals and ultrasharp tips. In this process, instead of directly patterning metal films, which are difficult to plasma-etch, we engineer inverse patterns in a silicon wafer. After metal deposition and peeling, ultrasmooth patterns in the silicon wafer are replicated onto a metal film. Ultrasmooth patterned metals have been used for near-field imaging, biosensing, and graphene plasmonics [2].

I will discuss lithographic patterning applications of ALD - atomic layer lithography – developed in our group. Using this unconventional approach, we have demonstrated wafer-scale production of centimeter-long and sub-10-nm wide gaps in various metals for sensing, optical trapping of biomolecules, and silicon-photonics-integrated plasmonic sensors.

[1] P. Nagpal, N. C. Lindquist, S.-H. Oh, D. J. Norris, ***Science*** (2009) 325, 594.

[2] I.-H. Lee, D. Yoo, Ph. Avouris, T. Low, S.-H. Oh. Graphene acoustic plasmon resonator for ultrasensitive infrared spectroscopy*.* ***Nature Nanotechnology***(2019) 14-313.

**Bio:** Sang-Hyun Oh obtained his B.S. in Physics from KAIST and Ph.D. in Applied Physics from Stanford University (advisor: Jim Plummer). After postdoctoral research at Bell Labs, Agere Systems, and UC Santa Barbara, he joined the ECE department at the University of Minnesota in 2006. Currently he is a Distinguished McKnight University Professor and a Bordeau Endowed Chair, and directs a lab focused on nanofabrication, biosensing, and nano-optics. He is a recipient of faculty awards from the Office of Naval Research, DARPA, NSF, ACS, and 3M. He was a visiting professor at Imperial College London and ETH Zurich in 2014.