Symmetry breaking in plasmonic complementary hole/disk structure

Reza Mohammadi[1], Maria Ochs[2], Annete Andrieu-Brunsen[2], and Nicolas Vogel[1]

[1] *Institute of Particle Technology, Friedrich-Alexander University Erlangen-Nürnberg, Erlangen, Germany*
[2] *Ernst-Berl-Institut für technische und makromolekulare Chemie, Technische Universität Darmstadt, 64289 Darmstadt, Germany*

In this research, we apply colloidal lithography[1] as an easy, fast and scalable technique to build unique symmetric and asymmetric complementary hole/disk architectures. Since in this process, (i) the colloidal particles with different sizes can be used, and (ii) the parameters used for the material deposition are well controllable, we can perfectly adjust the desired structural parameters of the fabricated architectures. Such novel architectures will then allow us to manipulate and customize their plasmonic properties via changing the available degrees of freedom in the fabrication process.

To study the plasmonic behavior of the symmetric and asymmetric complementary hole/disk structures, we measure their corresponding transmission spectrums experimentally and perform full wave electrodynamic simulations. In both architectures, we could reveal hybridized resonances as a result of coupling the resonances in hole and disk arrays. In addition, we could excite new hybrid resonances by introducing asymmetry to the complementary structure[2]. This new mode not only intensifies the enhanced near field, but also provides a narrower feature in the spectrum that makes the architecture a promising candidate for sensing applications[3].

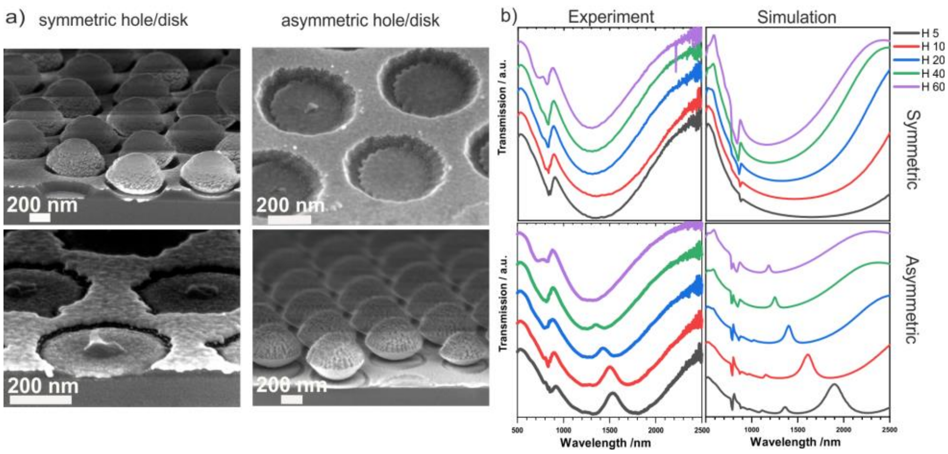

Figure 1. a) Scanning electron microscopy (SEM) side view of symmetric and asymmetric complementary hole/disk structure for two different heights b) Experimental and simulation transmission spectra of the complementary structures.

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[2] Hentschel, M., et. al., *Nano Lett.* **13** (2013) , 4428.
[3] Arif E. Cetin, et. al., ACS Photonics. **2** (2015) , 1167.

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