# Refracting surface plasmons with nanoparticle arrays

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Integrated plasmonics operates with surface plasmon polaritons (SPPs) and is hoped to substitute integrated optics, which suffers from its components being bulkier than electronic ones, but in turn much faster than those [1]. The success of development of this relatively young branch of physics depends on the variety of active and passive components available for the integration. Plasmonics, having features of both photonics and electronics, in terms of operational elements bears more resemblance to optics since Bragg mirrors, waveguides, beam splitters, and interferometers are used. For instance, dielectric optical elements for surface plasmons, featuring such functionality as focusing, refraction, and total internal reflection, have previously been demonstrated [2].

In this work we investigate variously shaped periodic gold nanostructures on top of a gold film having period much smaller than the wavelength. The SPP waves propagating along the surface inside a periodic array of nanoparticles experience an increase in the effective refractive index [3], and, for the array periods considerably smaller than the wavelength, relatively weak out-of-plane scattering [4]. Using leakage radiation microscopy (LRM), we show that those structures act as a refractive medium for SPPs featuring the effective refractive index (ERI) of about 1.08. This means that they can be used to make components for plasmonics, similar to optical prisms, lenses, and optical-fiber waveguides.

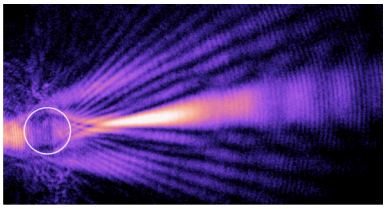

Figure shows a LRM image of a SPP beam scattered by a 7.5-μm-diameter circular-shaped periodic structure. The periodic structure is formed by 50-nm-high and 60-nm-wide rounded-square gold bumps on top of a gold film.

[1] R. Zia, J. A. Schuller, A. Chandran, M. L. Brongersma, "Plasmonics: the next chip-scale technology," Materials Today 9, 20-27 (2006).
[2] A. Hohenau, J. R. Krenn, A. L. Stepanov, A. Drezet, H. Ditlbacher, B. Steinberger, A. Leitner, F. R. Aussenegg, "Dielectric optical elements for surface plasmons," Opt. Lett. 30, 893-895 (2005).
[3] S. C. Kitson, W. L. Barnes, J. R. Sambles, "Full photonic band gap for surface modes in the visible," Phys. Rev. Lett. 77, 2670-2673 (1996).
[4] T. Søndergaard, S. I. Bozhevolnyi, A. Boltasseva, "Theoretical analysis of ridge gratings for long-range surface plasmon polaritons," Phys. Rev. B 73, 045320 (2006).