Researchers efficiently couple light from a plane wave into a surface plasmon mode

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Researchers from the NIST Center for Nanoscale Science and Technology have made a grating coupler that transmits over 45 % of the incident optical energy from a plane wave into a single surface plasmon polariton (SPP) mode propagating on a flat gold surface, an order-of-magnitude increase over any SPP grating coupler reported to date.

Surface plasmons are propagating waves of light tightly confined to a metal surface via coupling with oscillating electrons in the metal. SPPs have been used to route signals for optical interconnects and to concentrate light for molecular sensors.

The researchers' simple integrated coupler may improve performance and lower packaging costs for such devices and may also enable high-frequency optical connections between devices over longer distances. The researchers developed an analytical model of the coupling process to optimize the depth, width, and period of the identical rectangular grating groves that they nanofabricated on a gold surface.

Optical measurements on different sets of gratings confirmed the model's prediction that the highest efficiency would occur with "critical coupling," when the scattering by the grating groves is matched to the intrinsic losses of the SPP propagating on the grating. Because these couplers can be used to excite surface plasmonic devices more efficiently, the researchers expect that they will enable the development of a variety of future on-chip devices.

More information: An efficient large-area grating coupler for surface plasmon polaritons, S. T. Koev, et al., Plasmonics, published online November 2011, 1-9 (2011).

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