Linear Array of Metallic Waveguides Focuses Surface Plasmon Polaritons

One route to overcoming the diffraction limit in conventional optical devices is to utilize surface-plasmon polaritons (SPPs), which arise from the collective excitation of electrons at the interface between a conductor and an insulator. A standard method for generating surface plasmons is to shine light of the appropriate wavelength on a corrugated metal surface. An array of metallic waveguides not only can support but also can control the propagation of surface plasmons, as shown by X. Fan and G.P. Wang at Wuhan University, China, in the May 1 issue of *Optics Letters* (p. 1322). Through numerical simulations based on a finite-difference time-domain method, the researchers explain how a linear array of nanoscale waveguides made of silver can focus the propagating SPPs.

The plasmonic structure consists of an array of 30 identical waveguides arranged parallel to each other. Each waveguide is 2 μm long and 20 nm wide, and the spacing between adjacent waveguides is 30 nm. The waveguide metallization is a 20-nm-thick layer of Ag. There is a 20-nm air layer between the Ag layer and the substrate. Because of this design, the permittivity of the structure is periodically modulated, which can produce a negative refraction of the electromagnetic radiation. When the array is illuminated by a Gaussian optical beam focused at a point in front of the entrance facet of the array, the SPPs excited by the incident light are focused within the array. This occurs, according to the researchers, because the phase wavefront of the radiation entering the array is not planar but tilted with respect to the entrance facet. In contrast to the rays that enter the array in regions of dielectric only (which experience normal refraction), the rays penetrating the waveguide regions containing metallization change directions, effectively causing the light in those regions to experience negative refraction. In a similar fashion, the SPPs excited on each waveguide couple in an anomalous way and undergo negative refraction too, resulting in a focused spot of SPPs, said the researchers. In particular, report the researchers, a Gaussian optical beam with full width at half maximum of 265 nm positioned 250 nm in front of the waveguide can focus SPPs to a linewidth of 160 nm. The researchers said that the focusing of the SPPs could potentially be augmented by using convex or concave structures at the entrance to the waveguide array as well as by using thinner metallization layers. The researchers said that these metallic waveguide arrays can find important applications in subwavelength optical systems—for example, as optical interconnects in advanced nanophotonic devices.

TUSHAR PRASAD

Molecularly Imprinted Polyurethane Offers Economically Viable Route to Blood Typing

Although blood typing according to ABO antigens is common, the process that is typically used requires expensive and difficult-to-store antibodies. In the April 10 issue of *Angewandte Chemie International Edition* (p. 2626; DOI: 10.1002/anie.200502857), O. Hayden, K.-J. Mann, S. Krassnig, and F.L. Dickert of the University of Vienna reported the use of molecularly imprinted polyurethane to identify the blood group of red blood cells (RBCs) both in suspension and in whole blood. In addition to introducing a potentially more economical method for typing blood than is currently available, their research demonstrates the use of molecular imprinting for analytes larger than those that have been previously used.

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The researchers fabricated their molecularly imprinted polymer (MIP) devices by pressing a monolayer of RBCs of a given antigen type onto a thin layer of polyurethane. The polyurethane was pre-deposited on the sensor of a quartz microbalance for use in later measurements. The cured polymer bears the imprint of the cells, and after removal of the cell layer, the MIP retains toroid shapes characteristic of the cells, as seen by atomic force microscopy. Cell adsorption on the MIPs was then measured by monitoring the response of the quartz microbalance electrode beneath the MIPs relative to an electrode under an unimprinted surface. With this technique, the researchers showed that the greatest number of cells was adsorbed onto MIPs that had been imprinted with cells of the same blood type. This selectivity is especially remarkable, they said, in that all blood cells show nearly the same shape and are highly deformable, and the changes in imprint morphology caused by surface structures are extremely subtle. The researchers said that excess hydroxyl groups on the polyurethane substrates interact with the sugars of the antigens on the imprinting cells, creating a template for selective recognition on the molecular scale through increased hydrogen bonding capacity for the appropriate antigen.

KRISTA L. NIECE

Polymer–Silicon Microcantilevers Serve as Ultrasensitive IR Detectors

Medical imaging, weather forecasting, targeting, and reconnaissance are a few of the critical applications for infrared (IR) detectors. With temperature resolution (the smallest measurable temperature difference) of ~10 mK, traditional IR detectors are essentially photon detectors that require cryogenic cooling, which hampers miniaturization and cost reduction. Uncooled IR detectors, based on thermal detection and a bimaterial microcantilever design, have been fabricated in recent years. The microcantilevers bend reversibly because interfacial stresses develop due to a mismatch between the coefficients of thermal expansion (α) of the two materials. The thermal sensitivity (beam deflection per temperature difference) is mostly a function of the difference in α, in addition to geometrical and structure parameters. Heretofore, the best temperature resolution—approaching 10 mK—has been achieved with bimaterial microcantilevers combining silicon and gold as the high-α and low-α components, respectively, but current applications demand better performance. Recently, however, Iowa State University researcher V.V. Tsukruk, Air Force Research Laboratory researcher T.J. Bunning, and their co-researchers have replaced the contemporary metal–silicon bimorphs with a polymer–silicon hybrid design with much larger interfacial thermal stresses, resulting in temperature resolutions approaching 2 mK and thermal sensitivities of ~2 nm/mK, unprecedented values for uncooled detection.

As reported in the April 12 issue of *Nano Letters* (p. 730; DOI: 10.1021/nl0525305), the research team used plasma-enhanced chemical vapor deposition (PECVD) to selectively coat one side of silicon microcantilevers (~300 µm in length, ~30 µm in width, ~0.7 µm thick) commonly used in atomic force microscopy (AFM) with several highly cross-linked plasma polymers. In this publication, polystyrene (PS) is featured, and the PS-layer thicknesses were precisely controlled and confirmed by scanning electron microscopy and ellip-

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