

teau potentials of about 2.4 V for charge and about 2.3 V for discharge were observed in the galvanostatic charge-discharge curves, with a discharge capacity of about 120 mAh per g of LTO. After 60 cycles the battery retained 90% of its capacity with about 98% Coulombic efficiency, which suggested that all integrated components were working

efficiently.

The researchers also demonstrated the versatility of their battery design by connecting nine of them in parallel for a total energy of about 0.65 Wh. The research team glued an inexpensive polycrystalline silicon solar-cell array to the top of one cell and connected it with a current-limiter circuit. When fully

charged—with white light illumination for the single cell and with a galvanostat for the other eight—the device powered 40 red light-emitting diodes for more than 6 h (at 40 mA) and could be easily reconfigured to supply different voltages and current capacities.

Steven Trohalaki

“Needle beam” propagates without diffraction

An international team of researchers have demonstrated a new type of light beam that propagates without spreading outwards, remaining very narrow and controlled over an unprecedented distance. This “needle beam,” as the team calls it, may greatly reduce signal loss for on-chip optical systems such as used in nanophotonics, and may eventually assist the development of a more powerful class of microprocessors.

Federico Capasso of the Harvard School of Engineering and Applied Sciences (SEAS); Patrice Genevet, a research associate in Capasso’s group; Jean Dellinger of the Laboratoire Interdisciplinaire Carnot de Bourgogne, CNRS, in France; and their colleagues have characterized and created this needle beam, which travels efficiently at the interface of gold and air. Their findings were published in the August 31 online edition of *Physical Review Letters* (10.1103/PhysRevLett.109.093904).

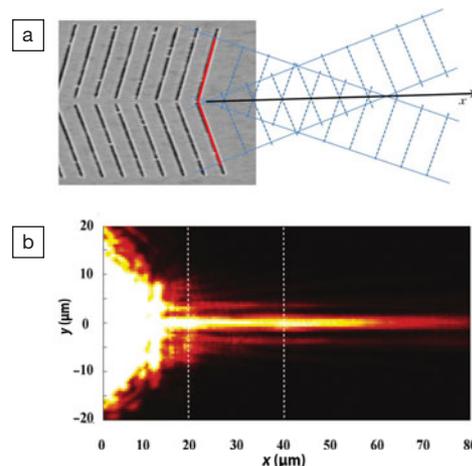
The needle beam arises from surface plasmons, a special class of quasiparticles, which travel in tight con-

finement with a metal surface. The metallic stripes that carry these surface plasmons have the potential to replace standard copper electrical interconnects in microprocessors, enabling ultrafast on-chip communications.

One of the fundamental problems that has so far hindered the development of such optical interconnects is the fact that all waves naturally spread laterally during propagation, known as diffraction. This reduces the portion of the signal that can actually be detected.

“We have made a major step toward solving this problem by discovering and experimentally confirming the existence of a previously overlooked solution of Maxwell’s equations that govern all light phenomena,” said Capasso, the Robert L. Wallace Professor of Applied Physics and Vinton Hayes Senior Research Fellow in Electrical Engineering at SEAS. “The solution is a highly localized surface plasmon wave that propagates for a long distance, approximately 80 microns in our experiments, in a straight line without any diffraction.”

The so-called needle beam, the technical term for which is a cosine-Gauss plasmon beam, propagates in tight confinement with a nanostructured metal



A cosine-Gauss plasmon beam, dubbed a “needle beam,” propagates without diffraction; (a) a micrograph and diagram of the metallic gratings that produce the needle beam and (b) experimental results. *Courtesy of Patrice Genevet.*

surface. The researchers sculpted two sets of grooves into a gold film that was plated onto the surface of a glass sheet. These tiny grooves intersect at an angle to form a metallic grating. When illuminated by a laser, the device launches two tilted, plane surface waves that interfere constructively to create the non-diffracting beam.

Slot-die coating may enable continuous printing of light-emitting electrochemical cells

Since the arrival of organic light-emitting diodes (OLEDs), the possibility of being able to economically print off rolls of electronic newspa-

per has become an exciting prospect. However, the continuous production of OLEDs under ambient conditions has been frustrated by the requirement for low-work-function cathode materials and a thin active layer. A promising alternative that suffers from neither of these constraints is the light-emitting electrochemical cell (LEC), and an ar-

ticle in the August 14 edition of *Nature Communications* (DOI: 10.1038/ncomms2002) describes how continuous ambient fabrication of these devices has recently been realized.

A. Sandstrom at Umeå University, Sweden, H.F. Dam at the Technical University of Denmark, and their co-workers used a slot-die roll coater, in which