

way of injecting light locally into a nanoscale photonic circuit.

The research team showed that the nanowires could even be successfully assembled into crossed and complex structures while still providing efficient waveguiding properties. These wires may thus become practical for usage in photonic elements with complex topology.

The research helps to resolve the fundamental problem of how to manipulate light in increasingly complex ways at very small scales, the researchers said. Their studies should have significant input on the development of novel computing technologies.

"However," Lieber said, "there are still remaining issues related to techniques to actually assemble such nanostructures efficiently and accurately."

If nanoscale assembling techniques are advanced further, CdS nanowire-based photonic elements may soon become reality in tomorrow's photonic circuits.

MARKUS J. BUEHLER

### Silica-Based Nanocomposite Turns Cotton into Superhydrophobic Fabric

Surfaces with water contact angles larger than 90° are deemed superhydrophobic. A superhydrophobic cotton fabric would have a myriad of commercial and industrial applications; however, cotton fabric has a highly hydrophilic surface with a water contact angle of 0°. Widely studied sol-gel methods for coating fibers to provide hydrophobic properties are based on fluoroalkyl compounds. These are expensive processes that carry byproducts, which could potentially damage the environment if fluorine compounds were dispersed or endanger human health after skin contact. W.A. Daoud, J.H. Xin, and X. Tao from the Hong Kong Polytechnic University have now presented an alternative coating method based on a silica nanocomposite. Among other advantages of using this silica-based nanocomposite are its transparency and the capability to be processed at a low temperature compatible with cotton and other fabrics.

As reported in the September issue of the *Journal of the American Ceramic Society* (p. 1782), the researchers mixed tetraethoxyorthosilicate (TEOS), 3-glycidyl-oxypropyltrimethoxysilane (GPTMS), and HCl in the optimal ratio of 1:0.118:0.008, respectively. They added hexadecyltrimethoxysilane (HDTMS) in 10 wt% of TEOS, obtaining a modified silica sol. The cotton fabric samples were first cleaned with a non-ionic detergent at 80°C for 30 min, then dipped in the modified silica sol for a minute, padded, air-

dried for 2 h and cured at 120°C for 1 h.

Measurements of the water contact angle were taken 1 min after placing a drop on the fabric, reporting 141°. Absorbency in uncoated cotton fabric was reported as 170% by volume of water sprayed, and after coating the absorbency decreased to 3%. The researchers conducted a standardized accelerated laundry test to simulate the effect of five consecutive wash cycles. After each wash cycle, the low level of absorbency increased and the water contact angle decreased continuously. After 30 wash cycles, the absorbency was up 17% and the water contact angle was 105°, still representing a highly hydrophobic fabric. Most of the increase in absorbency occurred after the first few wash cycles, and the hydrophobic properties reached a plateau after 15 cycles. The researchers attribute this high level of adherence to the addition of GPTMS to the modified silica sol.

The research team also studied the effect of the nanocomposite coating on the integrity of cotton fabric. Tearing strength did not change significantly, and tensile strength decreased less than 5%. When the investigators measured the permeability of the fabric (i.e., the ability of air to penetrate with a constant airflow), they reported a small increase after coating. This increase in permeability is an effect of the coating structure, they said, which deposits as round drops adhering to the fabric fibers. Therefore, they said, the nanocomposite coating enables cotton fabric to achieve consistent levels of water impermeability without losing its original properties.

SIARI SOSA

### Structurally Ordered Polymer Electrolytes Prepared by Casting under Magnetic Field

Despite efforts in the past 20 years to improve the conductivity of polymer electrolytes (PEs), the maximum conductivity of solid PEs remains around 10<sup>-5</sup> S/cm at room temperature. The problem is that in such semicrystalline materials commonly derived from the archetypal helical poly(ethylene oxide) (PEO), most of the helices lie parallel to the film plane, leading to low conductivity in the perpendicular direction where it is most important for electrochemical cells. Based on the idea that ionic conduction could be created by the movement of cations inside the helix and anions outside the chain, a group of researchers had recently used a stretching procedure to make a new group of structural ordering PEs from the archetypal helical PEO. In more recent work, the

researchers pursued the use of magnetic field—a non-mechanical means—to achieve orientation of the PEO helices perpendicular to the plane of the film. D. Golodnitsky of Tel Aviv University in Israel, S.H. Chung of William Paterson University in New Jersey, S. Suarez of Hunter College of the City University of New York, and their colleagues have found that the ionic conduction of their PEs could be increased in one direction by a longitudinal alignment of the helices. The researchers published their studies in the November issue of *Electrochemical and Solid-State Letters* (p. A412).

As reported, while casting Li:P(EO)<sub>n</sub> PEs (*n* = 3, 7, and 20), a strong magnetic field (0.8 T) produced from samarium-cobalt permanent magnets in the standard dipole arrangement was applied. Two different field configurations were used during the casting procedure: One was homogeneous and the other was highly inhomogeneous. After the solvent evaporation, a 100-μm-thick film was formed. In order to promote reorientation of the PE chains, diamagnetic alumina and ferromagnetic iron oxide were used as the additives. The incorporation of these nanosized inorganic fillers made a significant contribution to the magnetic field in PEs, the researchers said.

The orthogonally oriented macro- and microstructural changes of polymer segments and chains were studied from scanning electron microscopy and <sup>7</sup>Li-nuclear magnetic resonance spectroscopy. The PE's conductivity and PE/electrode interphase resistance were studied by a computer-interfaced frequency-response analyzer with a frequency range of 1 MHz to 0.1 Hz. Because the magnetic field was applied during the whole film casting process, both intra- and interchain ion mobilities were promoted by one order of magnitude. The researchers found that the lithium transference number increased from 0.2 to 0.6 in the magnetic-field-oriented PEs, which is important in battery applications; the resistance of the solid electrolyte interphase generated on the lithium electrode decreased by more than one order of magnitude. Due to the ability to make anisotropic, shape-persistent but flexible materials with preferred orientation, the researchers said this technique may enhance power in lithium batteries and possibly be applied in nanoscale technology.

LUCY YUE HU

### Spin Separation Achieved in GaAs Heterostructure

L.P. Rokhinson of Purdue University, Y.B. Lyanda-Geller of the Naval Research