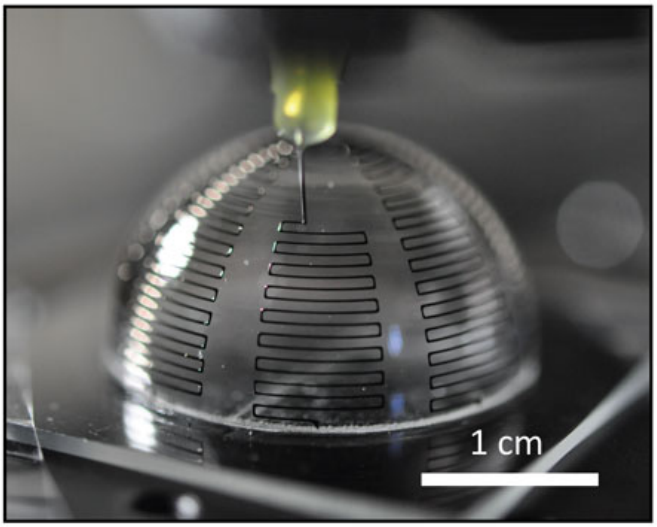
Researchers Print Conformal Electrically Small Antennas on Spherical Shapes



(Nanowerk Spotlight [1]) - Electrically small antennas (ESA) find use in a wide variety of communications platforms – e.g. mobile phones an other handheld devices, RFID, aerospace and defense systems – but their construction requires advances in printing as well as a robust antenna design so that their operating frequency, size, and system impedance could be easily varied.

In order for an antenna to be 'electrically small', the largest dimension of the antenna should be no more than one-tenth of a wavelength. For instance, a 9 square-centimeter RFID tag will have an antenna that is considered electrically small at any frequency below about ?1.1 GHz.

Researchers have now demonstrated the conformal printing of electrically small antennas on spherical shapes with a key performance metric (radiation quality factor or Q) that very closely approaches the fundamental limit dictated by physics (Chu limit; see: "Physical limitations of omnidirectional antennas").
"Our fundamental design approach enables specification of both operating frequency and size, while achieving near-optimal bandwidth at several frequencies of interest for wireless communications," Jennifer A. Lewis tells Nanowerk. "The ability to conformally print antennas that are compact and encapsulated within their support substrate further enhances their mechanical robustness. More broadly, conformal printing of conducting features may enable several applications, including flexible, implantable and wearable antennas, electronics, and sensors."

Lewis, the Hans Thurnauer Professor of Materials Science and Engineering, Willett Faculty Scholar of Engineering, and Director, F. Seitz Materials Research Laboratory at the University of Illinois at Urbana-Champaign (UI), together with Jennifer T. Bernhard, a professor in the Department of Electrical and Computer Engineering at UI, and their groups have published their findings in the January 19, 2011 online

edition of Advanced Materials ("Conformal Printing of Electrically Small Antennas on Three-Dimensional Surfaces").

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The 3D antennas are fabricated by conformal printing of a concentrated silver nanoparticle ink in a digitally programmed meander line pattern onto either the exterior (convex) or interior (concave) surface of a hollow glass hemisphere (if printed on the inside, the hollow glass hemisphere serves as a protective barrier, allowing the device to be easily handled and mounted). The researchers point out that, unlike planar substrates, the surface normal is constantly changing on curvilinear surfaces, which presents added fabrication challenges.

After printing and annealing at 550 °C, the patterned meander lines exhibit an electrical resistivity of ?5 × 10-6 ?·cm. The antenna's operating frequency is determined primarily by the printed conductor cross-section and the spacing (or pitch) between meander lines within each arm.

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