Manufacturing & Prototyping

Composite Layer Manufacturing With Fewer Interruptions

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An improved version of composite layer manufacturing (CLM) has been invented. CLM is a type of solid freeform fabrication (SFF) — an automated process in which a three-dimensional object is built up, point-by-point, through extrusion of a matrix / fiber composite-material precursor. The elements of SFF include (1) preparing a matrix resin in a form in which it will solidify subsequently, (2) mixing fibers and matrix material to form a continuous pre-impregnated tow (also called "towpreg"), and (3) dispensing the towpreg from a nozzle onto a base while moving the nozzle to form the dispensed material into a series of patterned layers of controlled thickness.

In CLM, the translation and the extrusion operation are such that the final size and shape of the fabricated object are as specified by a computer-aided design (CAD). Sometimes, in order to achieve the desired final shape, it is necessary to interrupt the deposition and cut the towpreg so that no material is deposited while the nozzle is translated to a position where deposition is to resume. The present improved version of CLM includes the use of an algorithm that generates a nozzle path with a minimum number of interruptions.

This work was done by Bor Z. Jang, Junhai Liu, and Shizu Chen of Auburn University for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809.

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Refer to MSC-23452-1, volume and number of this NASA Tech Briefs *issue, and the page number.*

Improved Photoresist Coating for Making CNT Field Emitters

This technique could contribute to development of cold cathodes for diverse applications.

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An improved photoresist-coating technique has been developed for use in the fabrication of carbon-nanotube- (CNT)-based field emitters of the type described in "Fabrication of Improved Carbon-Nanotube Field Emitters" (NPO-44996), *NASA Tech Briefs*, Vol. 32, No. 4 (April 2008), page 50. The improved photoresist-coating technique overcomes what, heretofore, has been a major difficulty in the fabrication process. This technique is expected to contribute to the realization of high-efficiency field emitters (cold cathodes) for diverse systems and devices that could include gas-ionization systems, klystrons, flat-panel display devices, cathode-ray tubes, scanning electron microscopes, and x-ray tubes.

To recapitulate from the cited prior article: One major element of the device design is to use a planar array of bundles of carbon nanotubes as the field-emission tips and to optimize the critical dimensions of the array (principally,

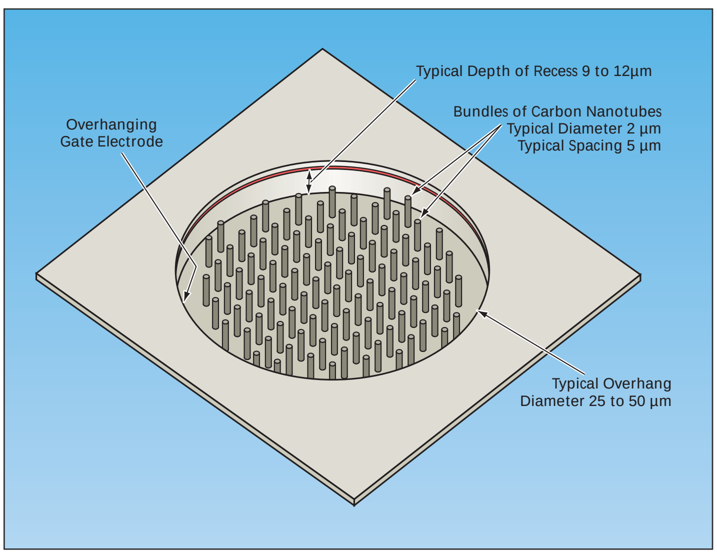

Figure 1. A **CNT-Based Field Emitter** of the type to which the present innovation applies includes a gate electrode that overhangs a recess containing an array of bundles of carbon nanotubes. For the sake of clarity, this drawing is simplified and not to scale.

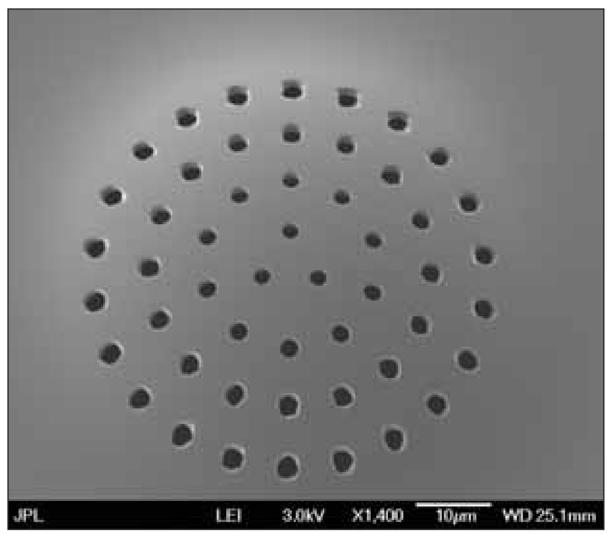

Figure 2. **Holes To Define Catalyst Dots** were formed in a photoresist membrane bridging a recess like that of Figure 1. This scanning electron micrograph was recorded at tilt angle of 20° to make the slight bulge of the membrane more visible.