C-MEMS and C-NEMS

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Carbon microelectromechanical systems (C-MEMS) and carbon nanoelectromechanical systems (C-NEMS) have received much attention because of their various potential applications, such as: miniaturized energy storage devices and biosensors. Microfabrication of carbon structures using top-down processing is time consuming and expensive. Low feature resolution, and poor repeatability of the carbon composition as well as widely varying properties of the resulting devices limit the use of screen-printing for miniaturization. 3D C-MEMS/NEMS microfabrication technique is based on pyrolysis of photo patterned resists at high temperatures in an oxygen free environment. It is possible to use the C-MEMS/NEMS technique to create various complex 3D carbon structures, such as: high aspect ratio carbon post arrays and suspended carbon nanowires, with a wide variety of shapes, resistivities and mechanical properties. We demonstrate that C-MEMS/NEMS with sizes ranging from the millimeter to the micrometer and even nanometer is very possible to provide solutions, alone or in combination with silicon and other organic, inorganic, and biological materials, in miniaturized on-chip energy and power systems (such as: Li-ion batteries, supercapacitors, biofuel cells) and biosensors (such as: lactic acid sensors and aptamer sensors).

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