Integration of Ruthenium oxide-Carbon Nanotube Composites with Three-Dimensional Interdigitated Microelectrodes for the Creation of On-Chip Supercapacitors

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A three-dimensional (3D) on-chip supercapacitor is fabricated by performing deep-ultraviolet lithography on a SU-8 photoresist. By using a cathodic deposition technique, ripple-like ruthenium oxide-carbon nanotube nanocomposites are synthesized. The carbon nanotube (CNT) network in the nanocomposite makes the electrolyte penetration easier and facilitates proton exchange and diffusion. A specific capacitance of $208.5 \text{ mF}\cdot\text{cm}^{-2}$ is achieved at $10 \text{ mV}\cdot\text{s}^{-1}$ in a neutral Na_2SO_4 solution. The interdigitated cell forms a supercapacitor when it is placed on a chip, and exhibits many desirable properties; the specific capacitance of as high as $28.70 \text{ mF}\cdot\text{cm}^{-2}$ is achieved at $120 \text{ mA}\cdot\text{cm}^{-2}$. The highest energy density ($25.99 \text{ mJ}\cdot\text{cm}^{-2}$) and the highest power density ($46.92 \text{ mW}\cdot\text{cm}^{-2}$) are also achieved with the interdigitated micro-supercapacitor. Therefore, 3D microstructures made with electrochemically deposited carbon nanotube composites are promising candidates for application as on-chip supercapacitors.

Keywords: On-chip supercapacitor; Ruthenium oxide; Carbon nanotubes; Interdigitated microstructures; Micro-electro-mechanical systems.

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