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Abstract :

The current trend towards miniaturized and autonomous electronic devices requires innovative energy storage solutions. For instance, autonomous micro-sensor networks or implantable medical devices would need a robust power source with high cyclability and a large power density, which might be out of the scope of conventional battery technologies. For such applications, microsupercapacitors (μ SCs) are promising alternatives, and their integration ?on-chip? could allow significant innovations. However, finding a suitable ?on-chip? μ SCs technology implies addressing key challenges, such as temperature resistance, silicon industry compatibility and good electrochemical performances on a small footprint. Nanostructures such as SiNWs and SiNTrs demonstrated excellent cyclability with more than 1 million cycles of galvanostatic charge/discharge under a 4 V wide electrochemical windows in EMI-TFSI ionic liquid, with large power densities and good capacitance values. Moreover, the use of silicon for electrode material allows extremely interesting developments towards ?on-chip? integration and potential scale-up production using standard silicon industry processes for small micro-sized energy storage devices.

Furthermore, we have also investigated the impact of the addition of a high-k dielectric layer, such as Al₂O₃ as protective films on silicon nanotrees. The electrochemical performances was enhanced, allowing symmetric 2 electrodes device to reach an unprecedented cell voltage of 5.5 V, improving energy and maximum power densities compared to unmodified nanostructured silicon. The cyclability was also largely enhanced, with only 3% capacitance fade after 1 million galvanostatic charge/discharge cycles at 4 V, and no degradation even after several 100000 cycles over 5 V.

Abstract Type : Invited