Coordination Polymer Framework-Based On-Chip Micro-Supercapacitors with AC Line-Filtering Performance

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On-chip micro-supercapacitors (MSCs) are important Si-compatible power source backups for miniaturized electronics, owing to their rapid energy-harvesting features, burst-mode power delivery, and in particular the good compatibility with Si. However, current on-chip MSCs require harsh processing conditions (high-temperature fabrication, oxygen plasma and wet-chemistry etching, etc.), and typically perform like resistors when filtering ripples from alternating current (AC). Therefore, the development of Si-compatible MSCs with facile fabrication procedure is an urgent task for their practical applications.

In this work, we demonstrated the first on-chip MSC based on a coordination polymer framework (PiCBA) by using a facile layer-by-layer strategy. Owing to the good carrier mobility (5 × 10^{-3} $cm^2 \cdot V^{-1} \cdot s^{-1}$) of PiCBA, strong interaction between PiCBA and patterned Au current collectors, and in-plane geometry, the as-fabricated MSCs delivered high specific capacitances of up to 34.1 $F \cdot cm^{-3}$ at 50 $mV \cdot s^{-1}$, a volumetric power density of 1323 $W \cdot cm^{-3}$ and an energy density of 4.7 $mWh \cdot cm^{-3}$. Moreover, the fabricated MSCs exhibited typical AC line-filtering performance (−73° at 120 Hz) with a short resistance-capacitance constant of ~0.83 ms, which is well comparable to the state-of-art MSCs. This study not only provides a general, easy method for the preparation of on-chip MSCs, but also demonstrates the remarkable energy storage potential of coordination polymer frameworks.

References

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Figures

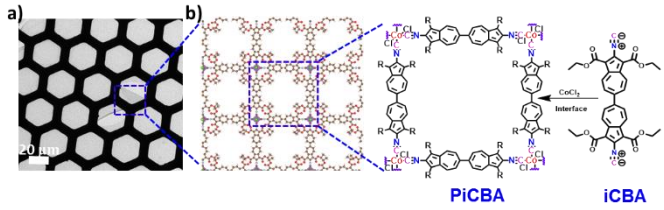

Figure 1. a) Uniform and free-standing PiCBA monolayer film; b) Synthesis of PiCBA film through the coordination reaction between isocyanide and cobalt ions.

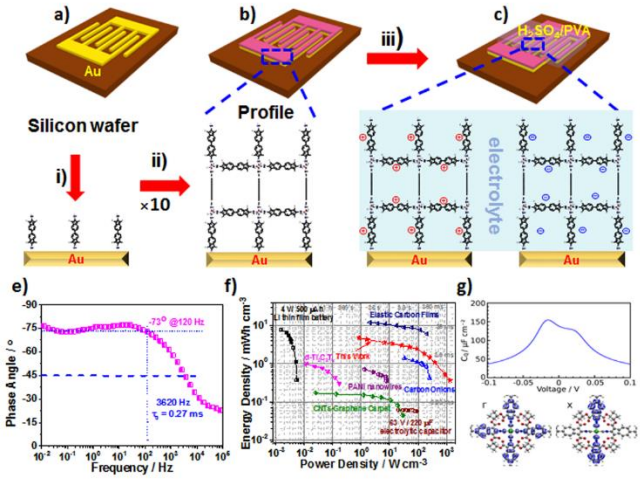

Figure 2. a-c) Schematic illustration of LBL fabrication of PiCBA films on Au interdigital electrodes; e) Impedance phase angle on the frequency for the PiCBA-based microdevices; f) Ragone plots for PiCBA; g) Calculated quantum capacitance.