Segmented All-Platinum Nanowires with Controlled Morphology through Manipulation of the Local Electrolyte Distribution in Fluidic Nanochannels during Electrodeposition

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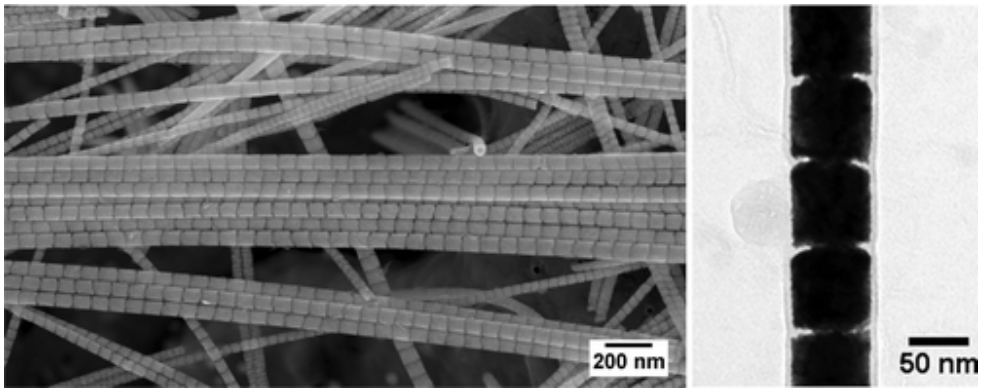

Synthesis of segmented all-Pt nanowires is achieved by a template-assisted method. The combination of a suitably chosen electrolyte/template system with pulse-reverse electrodeposition allows the formation of well-defined segments linked to nanowires. Manipulation of the morphology is obtained by controlling the electrokinetic effects on the local electrolyte distribution inside the nanochannels during the nanowire growth process, allowing a deviation from the continuously cylindrical geometry given by the nanoporous template. The length of the segments can be adjusted as a function of the cathodic pulse duration. Applying constant pulses leads to segments with homogeneous shape and dimensions along most of the total wire length. X-ray diffraction demonstrates that the preferred crystallite orientation of the polycrystalline wires varies with the average segment length. The results are explained considering transitions in texture formation with increasing thickness of the electrodeposit. A mechanism of segment formation is proposed based on structural characterizations. Nanowires with controlled segmented morphology are of great technological importance, because of the possibility to precisely control their substructure as a means of tuning their electrical, thermal, and optical properties. The concept we present in this work for electrodeposited platinum and track-etched polycarbonate membranes can be applied to other selected materials as well as templates and constitutes a general method to controlled nanostructuring and synthesis of shape controlled nanostructures.