Nano- to micro-sized carbon helical wires have been fabricated from the catalytic pyrolysis of acetylene in chemical vapor deposition (CVD). The synthesized helical wires can be categorized into twisted rope-like close packings. The mirror-imaged growth and one-to-one corresponding chirality changes in the paired chiral carbon helixes have provided a clear evidence to support the model of a rotating catalyst-particle during the helical growth. Left- and right-handed carbon helixes extrude simultaneously from two hemispheres of a rotating catalytic copper-particle, resembling the distinct vortical handedness of cyclones or oceanic hydrodynamic flows in the northern/southern hemisphere of the Earth. Electron microscopic image reveals that CHWs possess a graphite-short-range-ordering (GSRO) structure, which is consistent with Raman scattering measurement. The carbon helical wires can potentially be applied as nanoscaled device elements, e.g. inductive circuits, field emitters for flat panel displays, generators of magnetic beams, effective fillers in electromagnetic shielding materials, etc.
numbers are counted as a growing temporal sequence. (b) Schematic illustration for a rotating catalyst-particle model. Left- and right-handed helixes extrude simultaneously from two hemispheres of a rotating catalyst-particle. Pitch length, wire diameter, helix radius, and pitch angle are defined. (c d) SEM morphologies of twisted rope-like CHWs with total pitch number of 46 and 106, respectively. See a chiral change at $20 \rightarrow 21$ in (c). The enlarged image in d is magnified by three times. (e) The mirror-imaged growth and one-to-one corresponding chirality changes (pitch numbers: $2 \rightarrow 3$, $14 \rightarrow 15$, and $20 \rightarrow 21 \rightarrow 22$) in the CHWs. The lower pair of CHWs (labeled with 1 17) grew first, followed by the upper pair (labeled with 18 26). Vermicular fiber-like segments in the final stage of synthesis were caused by the translation, without rotation, of the copper particle due to lowering temperature in the end of experiment.