Supporting Information

High-Dense, Vertically Aligned Crystalline CrO₄ Nanorod Arrays Derived From Chemical Vapor Deposition Assisted by AAO Templates

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Experiment

Figure.S1 shows the schematic diagram of the fabrication process of CrO₂ nanorod arrays. AAO templates for CrO₂ deposition were prepared by two-step anodic anodization¹ of aluminum sheet (99.999%) in 0.3 M oxalic acid at a constant voltage of 40 V. Following anodization, the templates were soaked in a phosphoric acid solution (5%) at 30°C for 30 minutes to enlarge the diameter of the pores. The CVD deposition reactor consists of a quartz tube placed inside a furnace. During the deposition, a 1cm×1cm AAO template was placed vertically in the reaction zone, and CrO₃ (0.5g) was placed in the source zone. The temperature of the AAO template and the precursor was slowly increased to 380 °C and 260°C respectively, and then kept constant. Oxygen was used as carrying gas flowing from the source zone to reaction zone. Sublimed CrO₃ was transported to reaction zone and diffused into the pores of the AAO template where they decomposed into CrO₂ with evolution of O₂. CrO₂ initially grew along the AAO template pores, and finally overflowed on the surface of the AAO template to yield a continuous CrO₂ layer. After deposition, the overflowed CrO₂ surface layer was mechanically polished away using diamond nanoparticles carefully. And CrO₂ nanorod arrays were got in the AAO template. For XRD and magnetic measurements, epoxy resin was coated on the surface of the AAO template, serving as a protecting and holding layer, and the remanent Al metal on the back of the template was etched in a saturated CuCl₂ solution. While for SEM observation, the AAO template was further dissolved in 10% NaOH solution, and freestanding CrO₂ nanorods were got on the epoxy resin layer.
TEM Images

Figure S2 (a) Low-magnification TEM image of a single CrO$_2$ nanorod. (b), (c) and (d) HRTEM images marked in (a). These HRTEM images reveal that the nanorod is a single crystal.

Figure S3 (a) Low-magnification TEM image of a single CrO$_2$ nanorod. (b) and (c) Representative HRTEM images marked in (a), insets show the FFT images of the HRTEM images.

Figure S3 (a) shows a typical TEM image of CrO$_2$ nanorod which has a rhombohedral Cr$_2$O$_3$ crystal on the top. Figure S3 (b) shows the HRTEM image marked in (a), the two dimensional fast Fourier transform (FFT) of the lattice-resolved image (inset of the Figure S3 (b)) indexed to a tetragonal CrO$_2$ lattice. Figure S3 (c) shows the HRTEM image of the rod top (marked in Figure S3 (a)), the FFT image indexed to a rhombohedral chromic oxide (Cr$_2$O$_3$) lattice.

Reference