

### Synthesis & application of hollow hierarchical tungsten oxide nanostructures

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To date, nanostructured tungsten oxides with a variety of stoichiometries, such as  $\text{WO}_3$ ,  $\text{WO}_{2.9}$ ,  $\text{W}_{18}\text{O}_{49}$ , and  $\text{WO}_2$ , have been prepared, because they are promising candidates for applications such as gas sensors, photocatalysts, electrochromic devices, and field emission devices. Here, we report a facile one-pot solution-phase route to synthesizing a novel tungsten oxide hierarchical hollow structure without the requirement of catalysts, surfactants, or templates. The products consist of a  $\text{WO}_2$  hollow core sphere surrounded by a  $\text{W}_{18}\text{O}_{49}$  nanorod shell. The morphological evolution and the detailed growth mechanism were carefully studied. We also demonstrate that the size of the nanostructures is readily tunable by controlling the reactant concentrations. Interestingly, although bulk tungsten oxides are weakly paramagnetic or diamagnetic, the as-prepared products show unusual ferromagnetic behavior at room temperature. The nanostructures showed a good ability to remove an organic pollutant in waste water and are expected to be useful in many other applications.