Supporting information for

Chemical synthesis of CoO-ZnO:Co hetero-nanostructures and their ferromagnetism at room temperature†

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Experimental

ZnO Nanobelts were grown on Si wafer by thermal evaporation using the mixture between ZnO powders (99.9%, Aldrich), graphite powders (<20 micron, Aldrich) and Sn powders (99.8%, Acros). The source (ZnO: graphite: Sn = 1 : 1 : 0.01 by weight%) was loaded in the Al_2O_3 boat and was located in the center of quartz tube (diameter: 2.5 cm) and the alumina substrates placed 5 cm downstream from the source. After evacuating the quartz tube to ~ 9 x 10^{-2} torr using a rotary pump, the furnace temperature was increased to 900 °C. The ZnO nanobelts were grown for 20 minutes by a reaction between the source and Ar-O_2 mixture gas (Ar: 200 sccm, O_2:1 sccm). CoO NWs were prepared by the following procedures. The as-grown ZnO nanobelts on Si wafer and $CoCl_2$ (99.99%, Aldrich) were placed in the right and left part of Al_2O_3 boat (length 4 cm), respectively. After evacuating the quartz tube to ~ 9 x 10^{-2} torr using a rotary pump, the furnace temperature was increased to 700 °C and then was kept at the reaction temperature for 20 minutes under Ar. The CoO-ZnO:Co hetero-nanostructure structures were prepared by the following procedures. The as-prepared CoO nanowires on Si wafer and Zn powders (99.995%, Aldrich) were placed in the left and right part of Al_2O_3 boat (length 2 cm), respectively. After evacuating the quartz tube to ~ 9 x 10^{-2} torr using a rotary pump, the furnace temperature was increased to 450 °C and was kept at the reaction temperature for 10 minutes. The pressure of the quart tube reactor was kept at ~ 2 torr with Ar-O_2 mixture gas (Ar=500, O_2=1 sccm).

The structural properties were investigated by X-ray diffraction (XRD, Rigaku D/MAX-2500 V/PC). The morphology and composition were analyzed using scanning electron microscopy (SEM, Hitachi S-4700), field-emission TEM (FEI TECNAI G2 200 kV and Jeol JEM 2100F), electron energy loss spectroscopy (EELS, GATAN GIF-2000) in conjunction with TEM (TECNAI G2), and Energy dispersive X-ray spectroscopy (EDS). Magnetic properties were studied by superconducting quantum interference (SQUID, Quantum Design) magnetometer

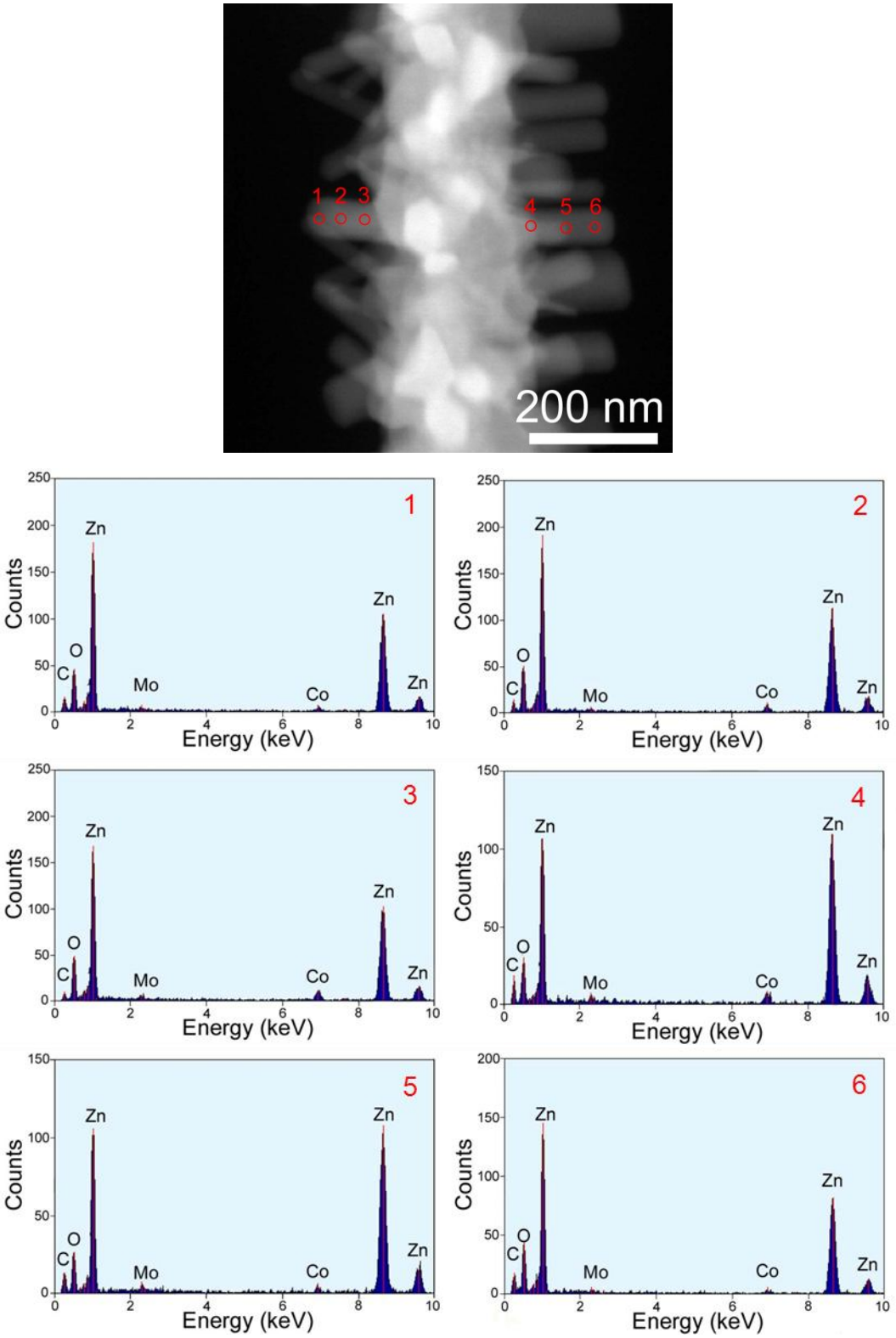

Fig. S1 EDS spectra of a CoO-ZnO:Co hetero-nanostructure

Point 1 Co 0.95 at%

Element	Weight (%)	Atomic (%)
O (K)	18.191	47.584
Co (K)	0.705	0.501
Zn (K)	81.102	51.913

Point 2 Co 2.5 at%

Element	Weight (%)	Atomic (%)
O (K)	21.792	53.179
Co (K)	1.767	1.171
Zn (K)	76.440	45.648

Point 3 Co 5.8at%

Element	Weight (%)	Atomic (%)
O (K)	17.140	45.665
Co (K)	4.368	3.159
Zn (K)	78.491	51.174

Point 4 Co 6.7 at%

Element	Weight (%)	Atomic (%)
O (K)	16.908	45.237
Co (K)	5.029	3.652
Zn (K)	78.062	51.109

Point 5 Co 3.1 at%

Element	Weight (%)	Atomic (%)
O (K)	18.045	47.287
Co (K)	2.277	1.620
Zn (K)	79.676	51.092

Point 6 Co 1.4 at%

Element	Weight (%)	Atomic (%)
O (K)	18.662	48.356
Co (K)	1.006	0.708
Zn (K)	80.330	50.935

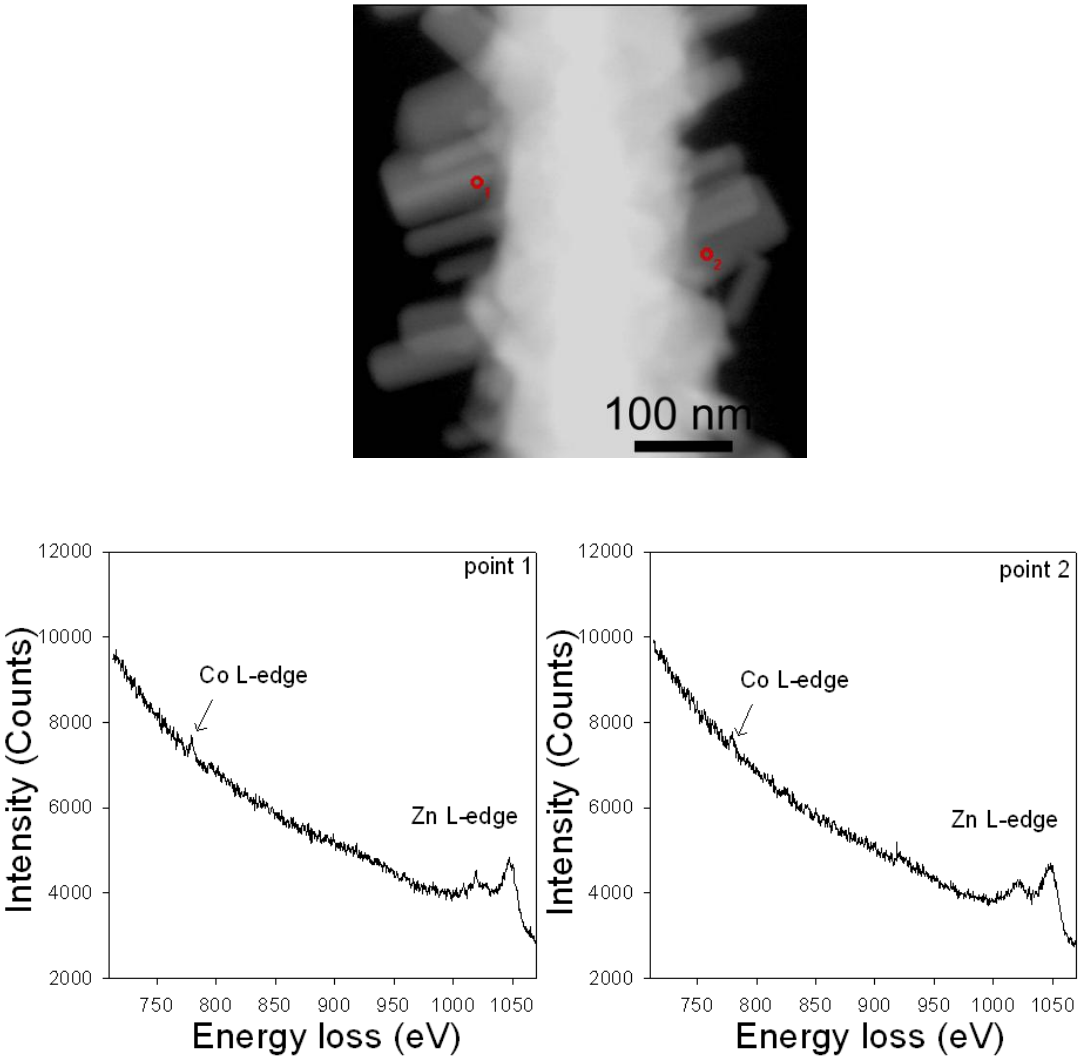

Fig. S2 The high-angle annular dark field (HAADF) scanning TEM (STEM) image and electron energy loss spectroscopy (EELS) spectra of a CoO-ZnO:Co hetero-nanostructure

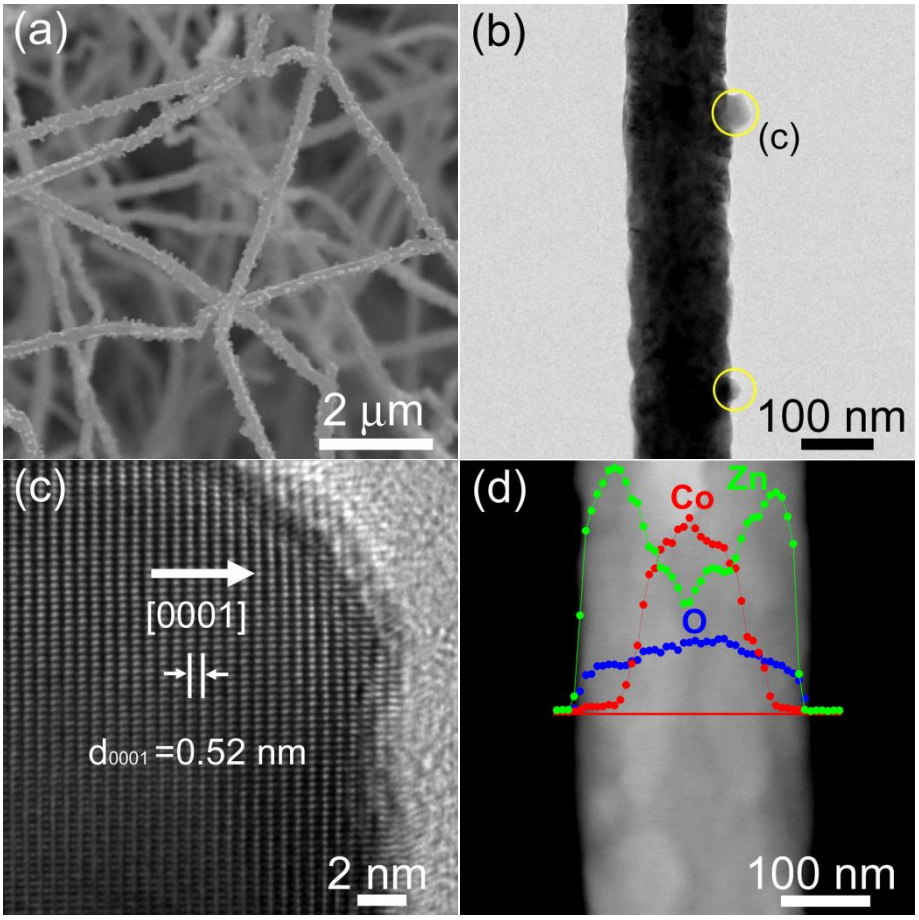

Fig. S3 Morphologies and crystal structures of CoO-ZnO:Co nanocables : (a) SEM image of CoO-ZnO:Co nanocables; (b) TEM image of a CoO-ZnO:Co nanocable; (c) Lattice-resolved image of a CoO-ZnO:Co nanocable; and (d) EDS line-scanning profile of Co, Zn, and O in a CoO-ZnO:Co nanocable