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Charge ordering and exchange bias behaviors in Co_3O_4 porous nanoplatelets and nanorings

J.C. Debnath [a,*], Jianli Wang [b], R. Zeng [b,c]

[a] Institute for Frontier Materials, Deakin University, Geelong, VIC 3216, Australia
[b] Institute for Superconductivity and Electronic Materials, University of Wollongong, Wollongong, NSW 2522, Australia
[c] School of Materials Science and Engineering, Faculty of Science, UNSW, Sydney NSW 2052, Australia

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ABSTRACT

We present the synthesis of α-Co_3O_4 porous nanoplatelets and hexagonal nanorings using microwave-assisted hydrothermal and conventional chemical reaction methods. The x-ray diffraction (XRD) and refinement analyses indicate the α-Co_3O_4 crystal structure, and the x-ray photoelectron spectrum (XPS) indicates the high purity of the samples. The M–T (including $1/\chi$–T) curves indicate an antiferromagnetic transition at about 35 K in both kind of samples but the interesting finding was made that a charge-ordered (CO) state appears at 250 K for the nanoplatelets sample whereas it is inattentive for the nanorings. The antiferromagnetic transition temperature T_N is lower than that of the bulk α-Co_3O_4 single crystal due to the nanosized structures. We observed quite significant exchange bias for nanorings. The exchange bias behavior of the α-Co_3O_4 hexagonal nanorings is consistent with an antiferromagnetic (AFM) Co_3O_4 core and spin-glass like shell.