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Magnetocaloric Effect in Ho_2O_3 Nanopowder at Cryogenic Temperature

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Abstract : Magnetic refrigeration provides an attractive alternative cooling technology due to its potential advantages such as high cooling efficiency, environmental friendliness, low noise, and compactness over the conventional cooling techniques based on gas compression. Magnetocaloric effect (MCE) occurs by changes in entropy (ΔS) and temperature (ΔT) under external magnetic fields. We have been focused on identifying materials with large MCE in two temperature regimes, not only room temperature but also at cryogenic temperature for specific technological applications, such as space science and liquefaction of hydrogen in fuel industry. To date, the commonly used materials for cryogenic refrigeration are based on hydrated salts. In the present work, we report giant MCE in rare earth Ho2O3 nanopowder at cryogenic temperature. HoN nanoparticles with average size of 30 nm were prepared by using plasma arc discharge method with gas composition of N2/H2 (80%/20%). The prepared HoN was sintered in air atmosphere at 1200 oC for 24 hrs to convert it into oxide. Structural and morphological properties were studied by XRD and SEM. XRD confirms the pure phase and cubic crystal structure of Ho2O3 without any impurity within error range. It has been discovered that Holmium oxide exhibits giant MCE at low temperature without magnetic hysteresis loss with the second-order antiferromagnetic phase transition with Néels temperature around 2 K. The maximum entropy change was found to be 25.2 J/kgK at an applied field of 6 T.

Keywords : magnetocaloric effect, Ho_2O_3, magnetic entropy change, nanopowder
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