Magnetocaloric properties of (RE)3Ga5O12
(RE=Tb,Gd,Nd,Dy)

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Abstract

We report the characteristic magnetic properties of several members of the rare earth garnet family, Gd3Ga5O12 (GGG), Dy3Ga5O12 (DGG), Tb3Ga5O12 (TGG), and Nd3Ga5O12 (NGG), and compare their relative potential utility for magnetocaloric cooling, including their minimal adiabatic demagnetisation refrigeration (ADR) temperatures and relative cooling parameters. A main objective of this work was to find potential improvements over the magnetocaloric properties of GGG for use in low temperature ADR cryostats. Using Tb³⁺ and Dy³⁺ in the RE-site offers in principle higher saturation magnetisation and Nd³⁺ gives a lower de Gennes factor and therefore potentially low transition temperature. Our results show that Dy3Ga5O12 yields an optimal relative cooling parameter (RCP ) at low applied fields and a low transition temperature, which would allow for the design of more efficient ADR cryostats.

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