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# Magnetocaloric properties of (RE)<sub>3</sub>Ga<sub>5</sub>O<sub>12</sub> (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, Gd<sub>3</sub>Ga<sub>5</sub>O<sub>12</sub> (GGG), Dy<sub>3</sub>Ga<sub>5</sub>O<sub>12</sub> (DGG), Tb<sub>3</sub>Ga<sub>5</sub>O<sub>12</sub> (TGG), and Nd<sub>3</sub>Ga<sub>5</sub>O<sub>12</sub> (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 Tb<sup>3+</sup> and Dy<sup>3+</sup> in the RE-site offers in principle higher saturation magnetisation and Nd<sup>3+</sup> gives a lower de Gennes factor and therefore potentially low transition temperature. Our results show that Dy<sub>3</sub>Ga<sub>5</sub>O<sub>12</sub> 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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