Rare earth magnets with a high Ce content

D. Goll[1*], R. Loeffler[1], M. Boettle[1], G. Schneider[1]

[1] Aalen University, Materials Research Institute, Germany
*dagmar.goll@hs-aalen.de

There is a large gap between weak, inexpensive, sustainable hard ferrite permanent magnets and the strong, expensive, less sustainable FeNdB rare earth magnets.

On a laboratory scale, it has recently been experimentally proven that FeNdB sintered magnets, in which 50-75% of the typically required amount of Nd/Neodymium is substituted by the more readily available and less expensive element Ce/Cer, can meet the performance requirements for use in an electric motor. For example, for sintered magnets Fe70.9-(Ce_xNd_{1-x})18.8-B5.8-M4.5 (at%; M = Co, Ti, Al, Ga, Cu; x = 0.5) at room temperature, a coercive field of μ_0H_c = 1.29 T, a remanence of J_r = 1.02 T and a maximum energy product of $(BH)_{max}$ = 176.5 kJ/m^3 (x = 0.75: μ_0H_c = 0.72 T, J_r = 0.80 T, $(BH)_{max}$ = 114.5 kJ/m^3) were achieved. They therefore have potential to close the gap between hard ferrites and FeNdB magnets. The additional use of La/Lanthanum allows tailoring of the magnetic properties and improvement of their temperature stability.

The talk gives an overview on the current state of the art and focuses on microstructure-property correlations, challenges and limits when Nd is substituted by Ce and on the positive influence of additives.