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Advanced approach to local magnetic field computation in magnetocaloric materials characterization

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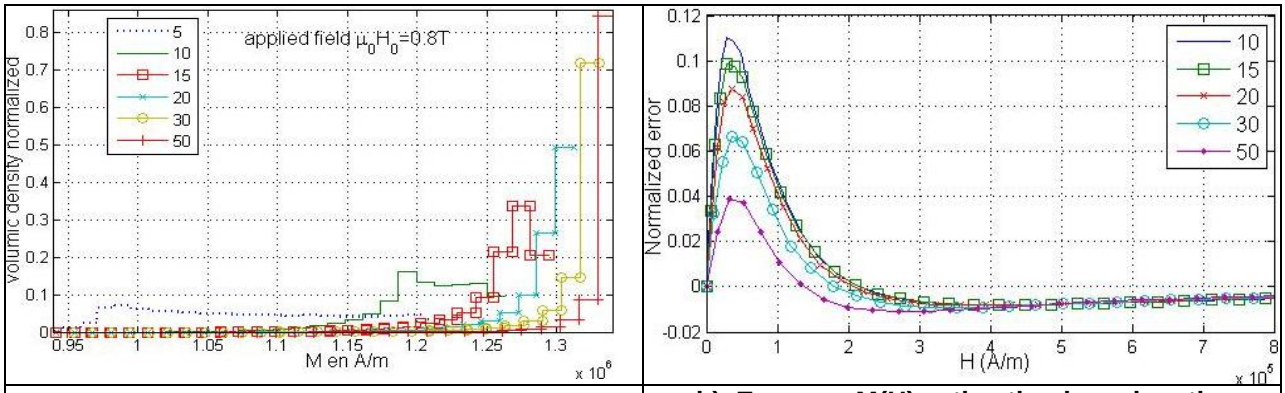
The knowledge of magnetocaloric materials properties as a function of temperature and magnetic field: M, S, ΔT_{adia}, C_H, λ, etc. is an important issue to design and optimize magnetic refrigeration systems. Magnetocaloric materials characterizations are based on magnetometry, calorimetry or direct temperature measurements. To obtain the intrinsic properties, experimental data must be adjusted considering the specimen shape and the demagnetizing field[1]. However, this requires a homogenous state variable. In practice, the demagnetizing field modifies the applied field and breaks its homogeneity which affects the final results (Figure 1a).

This paper presents an original approach to determine the intrinsic magnetization curve M(H) of a material whatever the shape of the sample is. It combines experiment, finite element simulation and inverse problem resolution. Its relevance is showed numerically. Simulations of different size cylinders are performed and allow the field inhomogeneity to be analyzed. Then, the internal field is computed considering the demagnetizing factor[2] (N) (Figure 1b) as well as the numerical inversion. This method is applied to characterize the M(H) of gadolinium using a parallelepiped sample along different orientations. The results are compared to the ones obtained with N correcting factor[3].



a) M inhomogeneity for an applied field of 0.8T

b) Error on M(H) estimation based on the demagnetizing factor

Figure 1 numerical simulation for a gadolinium cylinder with radius of 20 and height from 5 to 55

Keywords: demagnetizing field, demagnetizing factor, numerical inversion, homogeneity

1. Bahl, C. R. H. & Nielsen, K. K. The effect of demagnetization on the magnetocaloric properties of gadolinium. *J. Appl. Phys.* **105,** 013916–013916–5 (2009).
2. Chen, D.-X., Brug, J. A. & Goldfarb, R. B. Demagnetizing factors for cylinders. *Ieee Trans. Magn.* **27,** 3601 –3619 (1991).
3. Aharoni, A. Demagnetizing factors for rectangular ferromagnetic prisms. *J. Appl. Phys.* **83,** 3432–3434 (1998).

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