Mastering hysteresis in magnetocaloric materials

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Magnetic refrigeration technology is a fast-developing technology which is assumed to be capable to compete with and hopefully surpass the traditional vapour-compression refrigeration in terms of efficiency, device volume and weight and ecological compatibility in the near future. Magnetic materials showing a large magnetocaloric effect (MCE) with narrow hysteresis, particularly around room temperature, in moderate magnetic fields are needed to advance the technology.

A materials parameter´s library including the (cyclic) adiabatic temperature ΔT_{ad}, entropy ΔS, heat capacity c_p and thermal conductivity λ, of large number of candidate materials will presented. This data base comprises the most relevant magnetic refrigerants LaFeSi-, Heusler- and Fe_2P-type compounds but also manganites, FeRh and others.

This talk summarises then intrinsic and extrinsic contributions to thermal and magnetic hystereses and proposes strategies for at least partially overcoming the hysteresis problem in some selected classes of MCE materials with large application potential. Next, we compare their cyclic behaviours, their dynamic responses to various magnetic field rates and effects of fragmentation. Based on this, possible fabrication routes for efficient heat exchangers with secondary engineering properties suitable for application are shown. Finally, a MCE test bench allows the assessment of the above materials under real working conditions, the latter being quite different from the elaborated quasi-equilibrium measurements protocols commonly employed in the laboratory.

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