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A Magnetic Heat Pump With Porous Magneto Caloric Material

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At present magnetic refrigeration shows a realistic potential to penetrate some niche markets in the field of cold "production". It is well known that a refrigerator for cooling and a heat pump for heating are machines based on the same principle. After a small review on magnetic heat pump studies, a list of best suited applications is outlined and an engineering design concept for a magnetic heat pump with a rotary porous structure heat exchanger is presented. It involves magnetic heat flux line density distributions with the objective to obtain field's $_0H$ up to 2 T with not too heavy permanent magnets assemblies. The porous structures are geometrically optimized to obtain maximal magnetic field inductions. Some valuable recipes for their design are given. It is shown that for a water/ethylene-glycol magnetic heat pump the coefficient of performance is higher than that of a conventional heat pump.

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Magnetocaloric Manganites: Progress and Challenges

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Modern society relies very much on readily available refrigeration. The recently developed cooling technology based upon the magnetocaloric effect (MCE), that is, the magnetic refrigeration (MR) technology has provided an entirely new and superior approach over the conventional gas compression technique [1]. The major advantages of MR technology include high cooling efficiency, greatly compacted devices and environmental protection [1, 2]. In particular, MR covers a wide spectrum of applications in energy intensive industrial and commercial refrigerators such as large-scale air conditioners, heat pumps, supermarket refrigeration units, waste separation, chemical processing, gas liquification, liquor distilling, sugar refining, grain drying, and so forth. Since the MR technology uses a magnetic solid substance as a working refrigerant, the magnitude of magnetocaloric effect is often considered as a measure to whether or not a magnetic material can be used in magnetic refrigerators. The recent findings of new magnetocaloric materials have indeed opened up the new opportunities to use them as alternative working materials in active magnetic refrigerators that can operate within a wide range of temperatures from low to high temperatures [1-3]. Amongst a new class of magnetic manganites with perovskite-like structure ($R_{1-x}M_xMnO_3$, where R = La, Nd, Pr and M = Ca, Sr, Ba, Pb, etc.) has generated growing interest in the scientific community, owing to their superior magnetocaloric properties and less costs [3]. These materials are particularly promising for room-temperature magnetic refrigeration applications. This paper aims to review recent advances in magnetic refrigerant materials and place a particular emphasis on giving a high level of guidance in regard to the development of magnetocaloric manganites for the advanced magnetic refrigeration technology. The fundamental aspects of MCE as well as the criteria for selecting active magnetic refrigerants will be reviewed. The advantages and disadvantages of existing magnetocaloric manganites will be reviewed, analyzed and discussed, together with a comprehensive comparison of the MCE between the manganites andothers. Direction for future research in magnetocaloric manganites is also given.

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