

Thermal switch in a magnetic cooling engine: state of the art, opportunities and open challenges

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The substantial development of magnetic refrigeration (MR), derived by the recent scientific work in this area, allowed MR to stand today as the main alternative technology to traditional refrigerators system. Much progress has been made in various sectors necessary to bring this technology to the market, particularly in the areas of physics, materials and engineering [1]. The area of materials is probably the one most studied, both in advanced production processes and on the optimization of the magnetocaloric effect. Concerning the development of refrigerator systems, many prototypes have been developed in last 2 decades, supported by numerical simulations. Although this technology is in the cutting edge of its market implementation, with several refrigeration companies having already presented diverse products intended for short term commercialization, the scientific research is just now starting to explore new trends and applications based on this proven technology.

In this work one of these promising topics will be addressed, namely the development of a fully solid state magnetic refrigerator by using thermal switches. Although it is an old idea it has been hindered by the unsuccessful search for thermal-switches able to directionally control the flow of heat. The introduction to thermal switches and the respective working operation of a magnetic refrigerator will be discussed. Particular attention will be given to the state-of-art of these thermal switches.

Moreover, along the presentation our research towards a device/prototype will be revealed and discussed. This discussion will be based on our numerical simulations [2,3] and unpublished experimental results. Finally, the potential and opportunities for future applications will also be presented and analyzed

[1] A. Kitanovski, et al, U. Plaznik, U. Tomc, A. Poredoš, Engineering Advance 57 (2015)

[2] D.J. Silva, et. al, B.D. Bordalo, A.M. Pereira, J. Ventura and J.P. Araújo Applied Energy 93 (2012)

[3]] D.J. Silva, et. al, A.M. Pereira, J. Ventura and J.P. Araújo Applied Energy 113 (2014)