Scientists predict promising new family of materials for solid-state cooling

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In a new paper published in the *Nanoletters* journal, scientists from the University of Valencia point to a new family of materials with promising applications in solid-state cooling.

Scientists have long used solid-state cooling methods as an alternative to conventional refrigeration techniques that rely on pollutant gases. However, the efficiency of solid-state cooling has typically left much to be desired, being up to four times less efficient than conventional methods. Until now, the required mechano-caloric effects have only been observed in ferroelectric materials and superelastic metal alloys, both of which are very scarce and costly.

But the search for more efficient materials might be over. Physicists Daniel Errandonea, of the UV's Institute of Material Science (ICMUV), and Claudio Cazorla, of the School of Materials Science and Engineering, University of New South Wales (Australia), now predict that ion conducting materials such as fluorite (CaF2) might present a greater mechano-caloric effect than the ferroelectric group. In this light, ion conductors emerge as a new family of materials with promising applications in solid-state cooling. Additionally, fluorite is quite abundant in nature, with deposits in many countries, including Spain.

The study establishes the relationship between external mechanical tension and ionic transport in ion conductors using molecular dynamics (a computer simulation method for studying the physical movements of atoms and molecules) and quantum mechanics calculations.

The work shows that applying pressure to the material serves as an efficient means of adjusting critical temperature in superionic compounds (fast ion conductors).

These results, published in *Nanoletters* in April 2016, pave the way for a rational design of green cooling technologies that are not only more ecological, but more efficient and cost-effective than conventional cooling methods. They also have important implications for the development of solid-state batteries.

More information: Claudio Cazorla et al. Giant Mechanocaloric Effects in Fluorite-Structured Superionic Materials, *Nano Letters* (2016). DOI: 10.1021/acs.nanolett.6b00422

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