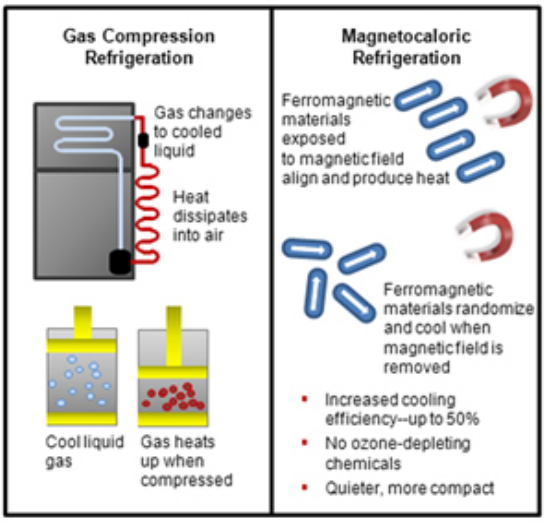
Did You Know? Magnetocaloric Nanostructures for Energy-Efficient Cooling

Do you know that your refrigerator is responsible for up to 20 percent of your electricity bill, second only to your heating and cooling system in the amount of energy used? University of Nebraska-Lincoln researcher Dr. Christian Binek has a goal of making your refrigerator up to 50 percent more efficient than it is today.

Residential and commercial refrigeration uses gas compression for cooling. Cold refrigerant gas in liquid form is condensed by a compressor until it becomes heated. The hot, compressed gas is then pushed out into coils on the outside of the unit where the heat dissipates into the air. The cool liquid gas moves through the freezer and refrigerator drawing heat out of the surrounding air. The cooled gas returns to the condenser and the process repeats.



Magnetic cooling has been around for a long time. When ferromagnetic materials are exposed to a magnetic field, they align and produce heat. When the magnetic field is removed, they randomize and cool. This alternative refrigeration process has only been used in cryogenic laboratory settings to study phenomena which takes place at temperatures only a few thousandth of a degree above zero of the absolute temperature scale. Binek is working to identify magnetocaloric materials that will perform at room temperature. His research is specifically looking at nanostructured and nanocomposite materials with magnetic properties that can be tailored for highly energy efficient cooling.

Not only will magnetic refrigeration increase energy efficiency, but no ozone depleting chemicals will be required, and eliminating the condenser will result in a quieter, more compact unit.

Binek and co-Principal Investigators Dr. David Sellmyer and Dr. Ralph Skomski received $100,000 in funding from the Nebraska Public Power District-sponsored Nebraska Center for Energy Sciences Research program, $50,000 from local company Teledyne Isco, which is partnering with Nebraska's Experimental Program to Stimulate Competitive Research (EPSCoR), and $250,000 from the Nebraska Research initiative.

The research team established the field of nanostructured thin film magnetocaloric materials and advanced the nanoparticle approach with significant contributions to the fundamental understanding of the role which magnetic and elastic degrees of freedom have for the cooling effect.

Currently, Binek is exchanging ideas with NUtech ventures aiming at an invention disclosure of a hitherto unexplored nanocomposite magnetocaloric material. This material will potentially eliminate the need for externally-applied magnetic fields to achieve cooling. If this new approach proves feasible, it will pave the way for ever-increased energy efficiency and miniaturization.
