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Demonstration of active magnetic regenerative refrigeration with pump-less system

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Active magnetic regenerative (AMR) refrigeration is well established concept of magnetic refrigeration which can generate a large temperature difference between both ends of a regenerator (AMR bed) by accumulating a lot of small temperature changes on every piece of magnetocaloric materials. In the AMR cycle, the magnetocaloric material and heat transfer fluid work collaboratively to accumulate a small temperature difference in the AMR bed. Specifically, magnetocaloric materials become warm by applying a magnetic field with magnets, and then, the warm heat transfer to one side of the AMR bed by the fluid flow. After that, magnetocaloric materials become cold by removing a magnetic field, and then, the coldness transfer to the other side of the AMR bed by the fluid flow in the opposite direction. In order to operate AMR cycle, both magnetic field changing mechanism and fluid flow mechanism are necessary. In many studies, the fluid flow is executed by piston motion or pumping. In this paper, we report a new concept of the AMR cycle operation in which fluid flow requires no power. We have developed a primitive rotary AMR apparatus with the only one source of power for the motor of rotating magnets. The reciprocating fluid flow motion can be accomplished by tug of war between magnetic force and elastic force of springs. More than 10 degrees in temperature difference have demonstrated between both ends of AMR bed by cycle operation with the only input for magnetic field changing mechanism. This concept will be effective to downsize and get higher efficiency of AMR cycle system.

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