Miniaturization of Heat-Actuated Cooling Using Microchannels

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The absorption cycle heat pump is one method for accomplishing heat-actuated cooling. In this cycle, the compressor of a vapor compression cycle is replaced by a thermo-chemical compressor, which absorbs the refrigerant vapor into a solution at low pressure and temperature and desorbs at high pressure and temperature. Instead of electricity driving the cycle through a mechanical compressor, heat supplied to a desorber along with a smaller amount of electricity to drive a solution pump are the energy inputs. By reducing the electricity requirements and running the system with high energy-density liquid fuels, the cooling system can be made more autonomous and portable. However, conventional absorption cycle technologies are large or inefficient, making them intractable for many portable applications. Efforts at miniaturizing the ammonia-water absorption cycle heat pump using microchannel technologies are described. Critical issues include mass transfer in the absorber and desorber and effective heat exchange for rejecting waste heat. Microchannel technologies offer a unique approach for intensifying these transport processes by reducing the characteristic length scale to approximately 100 microns. Progress in demonstrating miniaturized heat-actuated cooling in an ammonia-water absorption cycle breadboard at approximately 250 watts of cooling is described.