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GRAPHITE-DOPED COMPOSITE ADSORBENT COATINGS FOR HEAT-DRIVEN WATER SORPTION COOLING SYSTEMS

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Abstract

Thermally driven adsorption cooling systems can reduce the primary energy demand for air conditioning and refrigeration systems. Major challenges facing coated adsorption cooling systems include: low thermal conductivity, limited durability, control of coating thickness, and maintaining high adsorbate uptake. The overall performance of adsorption cooling systems can be improved by new composite materials and coatings developed to improve heat and mass transfer. In this study, silica gels with surface areas (S_{BET}) of 494 $m^2 \cdot g^{-1}$ were soaked with a salt and bindersolutions to produce adsorbent coatings. The properties of the coated materialswere evaluated by porosimetry and transient plane source thermal properties analysis. The thermal conductivity of the composite adsorbent coating was improved by adding graphite flakes with varying weight percentages. Thermal conductivity of the composite coating increased from 0.1 $W \cdot m^{-1} \cdot K^{-1}$(0 wt%graphite flakes) to 0.3$W \cdot m^{-1} \cdot K^{-1}$ (20 wt% graphite flakes); up to 230% enhancement in thermal conductivity of graphite-doped samples were obsrerved. Such significant enhancement in thermal conductivity can lead to considerable improvement in heat transfer in sorption bed, which in turn can lead to more compact sorption bed design and improved overal effeiciency and specific cooling capacity of any adsorption cooling system. Water uptake and multi-cycle performancestudies of the composite coating material were performed under adsorption cooling cycle conditions using a thermogravimetric vapour sorption analyser.