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# PARAFFIN-GRAPHENE/METAL FOAM COMPOSITE FOR THERMAL MANAGEMENT IN ELECTRONICS

**Abstract**

Thermal management systems for space vehicles often have to accommodate heat loads and thermal conditions that vary over time. Rejecting energy as it is generated can require large radiators, supplemental heat pumping, or expendables for a sublimator or evaporator. Active cooling requires relatively large amounts of power, and cannot easily and efficiently handle temperature spikes. On the other hand, phase change materials (PCM)-based heatsinks are able to tolerate short-term spikes in energy output with substantially less (or even no) active cooling. By varying the chemical composition of PCM one can tune its melting point and the temperature range in which it can operate as a heat absorber. Furthermore, high active heat transfer surface for the heat storage device can be obtained by employing metal structure. Good thermal conductivity, low density, high contact surface between metal and PCM are metallic structure advantages. We propose a comprehensive study on graphene-enhanced organic PCM impregnated in metal foam for thermal management in electronics capable of a ultra-rapid heat dissipation. The proposed approach for thermal management combines the increased thermal conductivity of a hybrid PCM-graphene acting as filler with the high active heat transfer surface of the metal foam. Graphene-enhanced organic PCM is prepared by high-shear mixing of solvothermal exfoliated graphenes with paraffin hydrocarbons. Then, the mixture is impregnated into a metallic foam matrix. The uniform dispersion and physical coupling of graphene within the paraffin matrix is verified using scanning electron microscopy and Raman spectroscopy- the interaction between graphene surface and paraffin induces a variation of the specific vibrational spectra of paraffin, which indicates changes in a paraffin's state and composition. Thermal behaviour is investigated by conventional differential scanning calorimetry (influence of nanoparticles on latent heat storage) and by thermo-gravimetric analysis (thermal stability). The PCM-graphene impregnated metal foam is tested in laboratory conditions in terms of heat transfer and energy storage rate. The experimental results indicate that the use of metal foam can improve the temperature uniformity of the PCM and increase the heat transfer rate.