An Investigation into the Application of Nano-Enhanced Phase Change Materials for Transient Thermal Management of Naval Electronics

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Phase Change Materials (PCMs) are materials which undergo a solid-liquid phase transformation at a temperature within the operating range of the thermal application. The latent heat of the phase change absorbs heat and maintains a constant operating temperature during the melt process. In transient applications, PCMs can be used to absorb heat and maintain operation at a specified temperature. PCMs have been shown to be effective in the thermal abatement of electronics by slowing the rate of temperature increase during transient operation. However, in larger volumes, the poor thermal conductivity of the PCM means that the thermal resistance into a large volume of PCM is considerable. The effectiveness of the PCM decreases significantly if the heat fails to penetrate into the overall volume, therefore, for high power applications the design must be adapted to facilitate greater heat flow into the PCM. The proposed research program will investigate the use of high conductivity carbon nanofibers to increase PCM conductivity without significantly increasing PCM weight or module size, leading to the development of effective, reliable, passive, modular cooling methods for high power transient Naval electronics.