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AN ANALYSIS OF THERMO-PHYSICAL PROPERTIES OF COPPER METALLIC NANOPARTICLES

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ABSTRACT

The analysis of thermo-physical properties of copper metallic nanoparticles is crucial in understanding their diverse applications in fields such as electronics, energy, and medical technologies. Copper nanoparticles exhibit unique properties compared to their bulk counterparts, mainly due to their high surface area-to-volume ratio and quantum size effects. Their thermal conductivity is significantly enhanced, making them excellent candidates for use in heat transfer applications, such as coolants in microelectronic devices and additives in thermal interface materials. Additionally, the specific heat capacity and melting point of copper nanoparticles tend to decrease as their size diminishes, a phenomenon attributed to surface atom activity. The electrical conductivity of these nanoparticles is also notable, making them suitable for developing efficient conductive inks and nanoelectronics. Analyzing these properties requires a combination of experimental techniques, like scanning electron microscopy (SEM) and X-ray diffraction (XRD), and theoretical modeling. Factors such as particle size, shape, and surrounding medium significantly influence the thermo-physical behavior of copper nanoparticles. Moreover, the impact of surface oxidation and agglomeration must be considered, as these can alter their properties. Understanding these factors is essential to optimizing the use of copper nanoparticles in advanced technologies, where precise thermal management and electrical performance are critical.