# A review of different models, mechanisms, theories and parameters in tuning the specific heat capacity of nano-phase change materials

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**ABSTRACT**

Cost-effective energy storage plays a critical role in transitioning towards a low-carbon society. Energy can be effectively stored as heat or electricity. Among various storage methods for high-temperature applications, molten salt tanks have gained significant popularity. Notably, molten salt tanks are 33 times more cost-effective than electric batteries in terms of storing a kilowatt-hour. Due to their favourable thermophysical properties, molten salts are the predominant phase change materials (PCMs) utilized for storage. Specifically, the specific heat capacity of the material is of particular interest when evaluating its thermal storage capacity, particularly in solar power plants. However, its low specific heat capacity is a major barrier to the widespread use of molten salt technology in energy storage applications. Therefore, minute quantities of nano-scaled particles within the molten salt mixture are important in enhancing the specific heat capacity ($C_p$). Consequently, studying these particles and their unpredictable nature has become a continuous research focus, with a clear understanding of the observed changes in specific heat capacity yet to be achieved. This article comprehensively reviews recent developments in theoretical models and mechanisms underlying heat capacity enhancement. Furthermore, it meticulously examines the influence of nanoparticle (NP) morphology (size, shape, and surface chemistry) as well as nanoparticle concentration on specific heat capacity, alongside the mechanisms contributing to enhanced thermal conductivity. Additionally, the impact of various factors such as heating rates, physical models, different differential scanning calorimetry (DSC) methods, sample moisture, and sample geometry on the specific heat capacity of the material is thoroughly considered and analyzed. By carefully assessing these parameters and conditions, including heating rate, geometry, and models/methods, this review offers valuable insights into selecting nanofluids with increased heat capacity for practical applications. Finally, the review highlights the key challenges and research gaps that need to be addressed for future advancements in nanofluid development and concludes by summarizing the main findings.

**KEYWORDS**
DSC models; Molten salt-based nanofluids; Nanoparticles; Specific heat capacity; Specific heat models

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