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Extended Abstract

High Temperature Nanocomposite Phase Change Materials Containing Mesoporous Silica Matrices †

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† Presented at the 15th International Symposium "Priorities of Chemistry for a Sustainable Development" PRIOCHEM, Bucharest, Romania, 30 October–1 November 2019.

Published: 18 October 2019

Keywords: phase change materials; mesoporous silica; molten salts; high temperature

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High temperature heat storage is an active field of research, especially for addressing the intermittency issues of solar power. Molten salts are used so far as sensible heat storage materials. Such materials can have greatly increased energy storage, if the solid-liquid phase transition is employed. However, the phase transition implies large changes in molar volume, leading to installation damage, leakage, and loss of storage. To alleviate this drawback, we proposed nanocomposites obtained by impregnating the salts into mesoporous silica, a porous matrix [1]. The resulting shape-stabilized phase change materials (ssPCMs) can be used for latent heat storage while preserving their solid shape. Mesoporous silica nanomaterials (MSN) were chosen as matrices because of their high thermal and chemical stability, large porosity, and monodisperse mesopore diameters [2]. The aim of the present study is to assess the influence of different textural properties of the MSN matrices (pore diameter, pore volume, surface area) on the thermal properties of the resulting nanocomposites. The ssPCMs obtained with molten nitrate eutectic show that 80% of the heat of fusion of pure salt can be attained for nanocomposites with 10% wt. silica. Alkaline earth halides are reactive towards the silica, leading to decreased heat storage. Salt eutectics with m.p. up to 520 °C could be used to obtain ssPCMs with heat of fusion values of up to 200 J/g. Shape-stabilized phase change materials containing mesoporous silica as matrix and molten salt eutectics can be obtained at high salt fraction. The nanocomposite shows good latent heat storage, up to ~80% of the pristine eutectic. Nanoconfinement effects can lead to a secondary phase with lower melting point than bulk (Figure 1). Larger pore diameters (≥9 nm) are required for salt nanoconfinement.

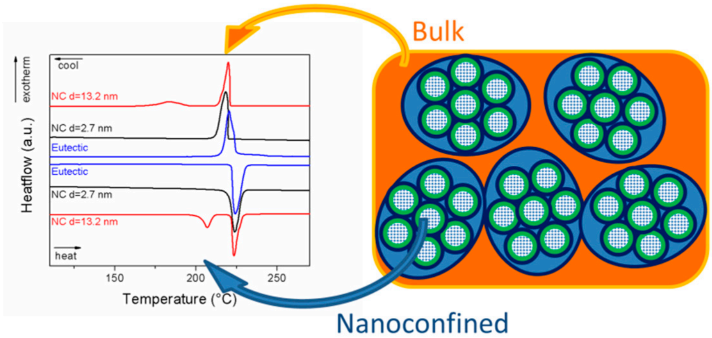

Figure 1. DSC data of molten salt eutectic and nanocomposites with mesoporous silica nanomaterials (MSN) with pore diameter of 2.7 and 13.2 nm (**left**), and schematic representation of salt distribution (**right**).

Acknowledgments*:* This work was supported by the Romanian Executive Agency for Higher Education, Research, Development and Innovation Funding (TE, No. 95/2018).

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