MgO and $Mg(OH)_2$/Poly Ethylene Glycol Composites as a Shape-Stabilized Phase Change Material for Thermal Energy Storage

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Abstract

Attention on phase change materials (PCMs) has increased significantly as a medium for solar energy storing. These materials are capable of absorbing and releasing huge quantities of latent heat during phase transformation. Organic Poly Ethylene Glycol (PEG) based PCM has gained growing attention because of their no supercooling and phase transfer properties. It is categorized as a good PCM due to its high chemical stability, high latent heat and eventually due to its suitable melting point. However, PEG also shows unavoidable drawbacks: the leaking during the phase transition process, and it displays a low thermal conductivity. In this study, MgO and $Mg(OH)_2$ with porous structure were prepared using different types of precipitating agents, including NaOH, KOH, NH_3 with paomic acid (PA) and NH_3CO_3 by hydrothermal method. Among the used precipitating agents, only NaOH provided single phase MgO powder, after calcination of the precipitate for 2h at 400^oC. The NH_3 with PA system increased the thermal stability of the as- synthesized materials. Depending on the properties of surface tension and capillary forces, the organic PEG can be mixed/bound inside the inorganic MgO or $Mg(OH)_2$ support. This approach allows PCMs to store and release heat in the melting/solidifying process without any leakage of the molten material. The high heat energy storage properties and good thermal stability of the organic (PEG)–inorganic (MgO or $Mg(OH)_2$) composite suggest the potential widespread applications. Particularly, $Mg(OH)_2$-PEG mixed PCM composite had almost no supercooling and also showed a high value of thermal storage efficiency than that of MgO-PEG composite PCM. The compatibility of the composite PCMs with the preserving material was studied by characterizing the surface properties. The Al and Sn sheet samples in contact with the PCM are largely corrosion-free, indicating that composite PCMs is compatible with Al or Sn surfaces under high-intensity solar radiation or humid condition.

Recent Publications

1. Mohamed SA, Al-Sulaiman FA, Ibrahim NI, Zahir MH (2017) A Review on Current Status and Challenges of Inorganic Phase Change Materials for Thermal Energy Storage Systems, Renew. Sustain. Energy Rev. 70:1072-1089.

2. Sari A, Al-Sulaiman FA, Zahir MH, Al-Ahmed A, (2017) Silica fume/capric acid-palmitic acid composite phase change material doped with CNTs for thermal energy storage, (2018) Solar Energy Materials and Solar Cells. 179:353-36.

3. Zahir MH, Nagano T, Rahman MM, Alhooshani K, Chowdhury S, Aziz MA, (2017) Microstructural investigations of tubular alfa-Al_2O_3-supported gamma-Al_2O_3 membranes and their hydrothermal improvement, improvement, Journal of the European Ceramic Society 37: 2637–2647.

4. Suzuki T, Zahir MH, Yamaguchi T, Fujishiro Y, Awano M, Sammes N (2010) Fabrication of micro-tubular solid oxide fuel cells with a single-grain-thick yttria stabilized zirconia electrolyte, Journal of Power Sources, 195:7825-7828.

5. Suzuki T, Zahir MH, Funahashi Y, Yamaguchi T, Fujishiro Y, Awano M (2009) Impact of anode microstructure on solid oxide fuel cells, Science, 325: 852-855.

Biography:

Dr. Zahir hold over seventeen years researcher position in three different Japanese National Research Institutes and participated in several research projects in environmental chemistry focusing on de-NOx catalysts, metal ion separation & purification, glucose sensor, hydrogen separation membranes, phase change materials for thermal energy storage and solid oxide fuel cells (SOFCs). Dr. Zahir was honored with various prestigious scholarships and awards including Monbusho scholarship, STA award, and NEDO fellowship from Japanese Govt. Dr. Zahir has almost 50 high impact research publications including one publication in the Journal of Science, one of the best prestigious journal in the world, inventor of about 20 US and Japanese patents.