Journal of Energy Storage

Recent advances on thermal energy storage using metal-organic frameworks (MOFs)

Nokubonga Makhanya[a,] Bilainu Oboirien[a,] Jianwei Ren[b,] Nicholas Musyok[acd,] Adriano Sciacovelli[e]

[a] Department of Chemical Engineering, University of Johannesburg, Doornfontein, Johannesburg 2028, South Africa

[b] Mechanical Engineering Science Department, University of Johannesburg, Johannesburg, South Africa

[c] Centre for Nanostructures and Advanced Materials (CeNAM), Chemicals Cluster, Council for Scientific and Industrial Research (CSIR), Pretoria 0001, South Africa

[d] Energy Sensors and Multifunctional Nanomaterials Research Group, Department of Applied Chemistry, University of Johannesburg, Doornfontein, South Africa

[e] School of Chemical Engineering, Birmingham Centre for Energy Storage (BCES), University of Birmingham Edgbaston, Birmingham, B15 2TT, UK

https://www.sciencedirect.com/science/article/pii/S2352152X20320041

Abstract

The development of novel efficient materials for thermal energy storage (TES) is an important step in the storage and utilisation of renewable energy. During the charging period, TES process stores heat and later releases it during the discharging period. TES is a technology that can be utilized in residential heat storage systems for building application and heating/cooling (refrigeration), solar plants in making thin films for solar cells (photovoltaic cells) and industrial processes such as in metallurgy, seawater desalination, air-conditioners and adsorptive heat transformations for heat pumps. Metal-organic frameworks (MOFs) are a novel class of porous materials with intriguing properties such as high stability, high inner surface areas and tuneable pore sizes. MOFs have also been utilized in adsorption thermal energy storage (ATES) applications; however, very limited information is available from the literature on the performance of MOFs in ATES and their comparisons to conventional adsorbents. This work presents a comprehensive review on the application of MOFS for ATES through evaluation of the recent developments and their use in adsorption thermal energy storage applications. Strategies to improve operating conditions and MOFs performance in ATES and the gaps in knowledge are identified. Recommendations and future research needs are also provided.