A Binary Salt Mixture LiCl–LiOH for Thermal Energy Storage

ABSTRACT

For thermal energy storage, the most promising method that has been considered is latent heat storage associated with molten salt mixtures as phase-change material (PCM). The binary salt mixture lithium chloride—lithium hydroxide (LiCl–LiOH) with a specific composition can store thermal energy. However, to the best of our knowledge, there is no information on their thermal stability in previous literature. The key objectives of this article were to investigate the thermophysical properties, thermal repeatability, and thermal decomposition behavior of the chosen binary salt mixture. FactSage software was used to determine the composition of the binary salt mixture. Thermophysical properties were investigated with a simultaneous thermal analyzer (STA). The thermal results show that the binary salt 32 mol% LiCl-68 mol% LiOH melts within the range of 269 ◦C to 292 ◦C and its heat of fusion is 379 J/g. Thermal repeatability was tested with a thermogravimetric analyzer (TGA) for 30 heating and cooling cycles, which resulted in little change to the melting temperature and heat of fusion. Thermal decomposition analysis indicated negligible weight loss until 500 ◦C and showed good thermal stability. Chemical and structural instability was verified by X-ray diffraction (XRD) by analysing the binary salt system before and after thermal treatment. A minor peak corresponding to lithium oxide was observed in the sample decomposed at 700 ◦C which resulted from the decomposition of LiOH at high temperature. The morphology and elemental distribution examinations of the binary salt mixture were carried out via scanning electron microscopy (SEM) coupled with energy dispersive spectroscopy (EDS). X-ray photoelectron spectroscopy was conducted for surface analysis, and their elemental composition verified the chemical stability of the binary salt mixture. Overall, the results confirmed that the binary salt mixture is a potential candidate to be used as thermal energy storage material in energy storage applications of up to 500 ◦C.