Thermal emissivity spectra and structural phase transitions of the eutectic Mg-51%Zn alloy: A candidate for thermal energy storage


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Highlights

• Spectral and total emissivity are obtained in order to study heat radiation losses.
• Temperature dependent spectral emissivity curves for the Mg-51%Zn alloy are obtained.
• Radiometer sensitivity allows detecting a structural solid-solid phase transition.
• No oxidation is observed in emissivity measurements after open air exposure.

Abstract

The thermal emissivity spectrum in the mid infrared range (3–21 μm) as well as its dependence on temperature between 225 and 320 °C has been obtained for the Mg-51%Zn (weight %) eutectic alloy, a candidate for thermal storage. The spectral curves show the typical behaviour of metals and alloys, with emissivity values between 0.05 and 0.2. It was also found that the emissivity spectrum shows variations in each heating cycle during the first few cycles. These changes are associated with the presence of metastable phases in the solid-solid phase transition, present in the alloy below the melting point. The absence of signs of oxidation in air is very favourable for the use of this alloy in thermal energy storage systems. Moreover, the total normal emissivity curves obtained from dynamic spectral measurements have allowed analysing the behaviour phase transition sequence present in this alloy. These experimental results indicate that accurate emissivity measurements can be sensitive enough to account for the structural phase transitions in metals and alloys.

Keywords

Alloys; Thermal emissivity; Thermal energy storage; Thermosolar energy; Structural phase transitions