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Sensitivity of thermal emission spectroscopy for the study of structural phase transitions

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Highlights

- The emissivity temperature dependence of the Zn-3%Mg-4%Al Alloy is studied.
- DSC & XRD analysis confirm the presence of a first order solid-solid phase transition.
- The solid-solid phase transition is detected with spectral & total emissivity.
- Emission spectroscopy is a powerful alternative for the study of phase transitions.
- Emissivity detection capacity for phase transitions is wavelength dependent.

Abstract

High-accuracy thermal emission spectroscopy offers certain advantages over other infrared surface spectroscopic techniques. This paper demonstrates the sensitivity and versatility of this method in the study of structural phase transitions. To that end, the Zn-3%Mg-4%Al (mass %) alloy has been used, as it possesses a first-order structural phase transition with a weak calorimetric signal around 270 °C. Both the infrared spectral emissivity and the integrated total emissivity show the typical first order step, whose value has a strong spectral dependence, with the effect continuously decreasing as the wavelength increases until it can no longer be detected beyond 10 μm. Therefore, this means that this transformation is more easily observed through its effect on interband transitions, whose energies typically lie within the near and mid-infrared regions. Some of the advantages of this technique are also discussed in this work and the results are compared to those of temperature-dependent X-ray diffraction and differential scanning calorimetry.

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