

In situ Raman spectroscopy measurements of MgAl₂O₄ spinel up to 1400 °C

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ABSTRACT

In-situ Raman measurements using a gated spectroscopy system revealed irreversible changes at 800–1000 °C in a natural red spinel (with 2 cation mol% Cr and 1 cation mol% Zn) and at 1100–1200 °C in a natural clear spinel (without Cr or Zn). Our observations of rapid broadening of a mode at 409 cm⁻¹ and the appearance of two weak modes at 210 and 520 cm⁻¹ at the transition temperature confirm the association of these features with cation disordering proposed by previous quench studies. Furthermore, we found that the frequencies of modes at 313 and 666 cm⁻¹ change at the transition temperature. The discontinuous frequency decrease of the mode at 313 cm⁻¹ and the increase in the frequency of the mode at 666 cm⁻¹ can be explained by the entrance of heavier Al atoms into the tetrahedral sites and the entrance of lighter Mg atoms into the octahedral sites, respectively. Our study demonstrates that in-situ Raman spectroscopy is a powerful tool for studying cation disordering in spinel-structured minerals at high temperature.

Keywords: Spinel, Raman spectroscopy, order-disorder transition, high temperature