American Mineralogist, Volume 97, pages 1314–1319, 2012

Redetermination of high-temperature heat capacity of Mg_2SiO_4 ringwoodite: Measurement and lattice vibrational model calculation

Hiroshi Kojitani,[1,*] Madoka Oohata,[1] Toru Inoue,[2] and Masaki Akaogi[1]

[1]Department of Chemistry, Faculty of Science, Gakushuin University, 1-5-1 Mejiro, Toshima-ku, Tokyo 171-8588, Japan
[2]Geodynamics Research Center, Ehime University, 2-5 Bunkyo-cho, Matsuyama 790-8577, Japan

Abstract

Isobaric heat capacities (C_P) of Mg_2SiO_4 forsterite and ringwoodite were measured by differential scanning calorimetry in the temperature range of 306–833 K. The measured C_P of Mg_2SiO_4 forsterite was consistent with those reported by previous studies. On the other hand, the present C_P of Mg_2SiO_4 ringwoodite was about 3–5% larger than those measured by previous researchers. The calorimetric data of Mg_2SiO_4 ringwoodite were extrapolated to 2500 K using a lattice vibrational model calculation, which well reproduced the low-temperature C_P data measured by thermal relaxation method. The calculated C_P shows good agreement with the present calorimetric data. The obtained C_P was expressed by the polynomial of temperature: $C_P = 164.30 + 1.0216 \times 10^{-2}T + 7.6665 \times 10^{3}T^{-1} - 1.1595 \times 10^{7}T^{-2} + 1.3807 \times 10^{9}T^{-3}$ [J/(mol·K)] in the range of 250–2500 K.

Keywords: Mg_2SiO_4, ringwoodite, heat capacity, DSC, Kieffer model calculation, thermodynamic property, mantle transition zone