

FORMATION, ABSORPTION AND EMISSION SPECTRA OF Cr⁴⁺ IONS IN Li₂O-SiO₂ SYSTEM TRANSPARENT GLASS-CERAMICS

Shigeki Morimoto

School of Ceramic Engineering, Institute of Engineering, Suranaree University of Technology,
111 University Avenue, Muang District, Nakhon Ratchasima 30000, Thailand

Abstract

The formation mechanism, optical absorption and emission spectra of Cr⁴⁺ ions-containing Li₂O-SiO₂ system transparent glass-ceramics were investigated. In the material, the main crystalline phase was Li₂O-2SiO₂, and the percent crystallinity and crystal size were 67-72 and 20-33 nm, respectively. The remarkable change in color and absorption spectra was observed upon crystallization. The characteristic emission of tetrahedrally coordinated Cr⁴⁺ ions was identified in the near infrared region, 1000-1600 nm. It was found that tetrahedrally coordinated Cr⁴⁺ ions exist in this transparent glass-ceramics from absorption and emission measurement. The Cr⁴⁺ ions exist in residual high SiO₂ glassy phase, and their ligand field parameters are estimated to be: 10Dq = 10,610 cm⁻¹, B = 690 cm⁻¹ and Dq/B = 1.54. This Dq/B value is just below the crossing point of ³T₂ and ¹E levels (Dq/B = 1.6). The Cr⁴⁺ ions in Li₂O-SiO₂ system transparent glass-ceramics occupy the little stronger ligand field sites than those in aluminate glass reported previously (Dq/B = 1.2). It is considered that the Cr⁴⁺ ions can be formed by the reduction of Cr⁶⁺ ions (chromate ion [CrO₄]²⁻) associated with decreasing the basicity of residual glassy phase during crystallization. In this process the behavior of Li⁺ ions plays a significant role. The [CrO₄] formed is equivalent to [SiO₄] and substitutes [SiO₄] sites in the residual high SiO₂ glassy phase.

Keywords : Li₂O-LiO₂ system, Transparent glass-ceramics, Tetrahedrally coordinated Cr⁴⁺ ions,
Emission spectra

Published in : Journal of Ceramic Society of Japan, Vol. 112, 2004, pp. 486-490.