

Crystallization kinetics phenomena assessment in a glass-ceramic material, by non-destructive spectroscopic methods

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Abstract : Non destructive tests are very useful to follow crystallization kinetics phenomena during the synthesis of aluminosilicate glass-ceramic materials. These composite matrices are dedicated for nuclear waste storage. In this study, we assessed the crystallization kinetics dependence, by many non destructive tests, on the structure of an aluminosilicate glass ceramic ceramized by a nucleation crystallization treatment at 790°C during 2 h, and 900°C, for different periods of time ranging from 6 to 12 h. These tests are X-ray diffraction; scanning electron microscopy and Fourier transform Infra-red spectroscopy. For the whole of materials, Archimedes density is between 2530-2578 kg/m³. Both X-ray diffraction and scanning electron microscopy analyses reveal two main crystalline phases for the whole of heating treatments, namely spodumen and leucite. These phases grow regularly with the crystallization time. FTIR analysis shows Si-O-Si vibrations (680 cm⁻¹ and 457-467 cm⁻¹), which shift toward lower values indicating Si-O-Me bonds formation (Me = metal), which are abundant for high ceramization times. The metals incorporated in the materials structure are well binded in the structure, conferring it durable properties. These non-destructive spectroscopic techniques allow following crystallization progress in the materials without altering the materials bulk, and are recommended for such studies.

Keywords : glass-ceramic, aluminosilicate glass, FTIR, SEM, XRD