Transition metal stuffing in quartz solid solutions synthesized by containerless melting

Alessio Zandona*†[1], Haytem Bazzaoui[1], Cécile Genevois[1], Emmanuel Veron[1], Michael Pitcher[1], and Mathieu Allix[1]

[1]Conditions Extrêmes et Matériaux : Haute Température et Irradiation – Centre National de la Recherche Scientifique, Centre National de la Recherche Scientifique : UPR3079 – France

Abstract

Aluminosilicate quartz solid solutions represent the main functional component of state-of-the-art thermal-shock-resistant glass-ceramics, since their thermal expansion behaviour can be finely tuned by structural stuffing with Li+, Mg2+ and/or Zn2+ ions. Drawing from recent experimental findings, this oral contribution reports the possibility of stuffing the quartz structure also with transition metal ions (Mn2+, Ni2+, Fe2+, Co2+). Aerodynamic levitation coupled to laser heating was used to synthesize glasses rich in transition metal oxides, which were then crystallized into Li-free stuffed derivatives of quartz. Their crystalline structure was carefully characterized using synchrotron and neutron diffraction. The examination of crystal symmetry, unit cell distortion and chemical substitutions over a vast compositional domain allowed to determine the key structural features leading to the isotropic zero thermal expansion exhibited by Co2+-stuffed quartz solid solution crystals.

Keywords: stuffed derivatives of quartz, aerodynamic levitation, diffraction, thermal expansion

*Speaker

†Corresponding author: alessio.zandona@tu-clausthal.de