PHOTOLUMINESCENCE IN γ-IRRADIATED α-QUARTZ INVESTIGATED BY SYNCHROTRON RADIATION

M. Cannas[1], S. Agnello[1], R. Boscaino[1], F.M. Gelardi[1], A. Trukhin[2]

[1] *INFM&Dipartimento di Scienze Fisiche ad Astronomiche dell' Università di Palermo, Via Archirafi 36, 90123 Palermo, Italy*

[2] *Institute of Solid State Physics, AS CR, University of Latvia, Kengaraga iela 8, LV-1063 Riga, Latvia*

Investigation and comparison of the optical properties in different forms of SiO_2, crystalline quartz and amorphous silica, is a crucial aspect in understanding the structure of intrinsic defects. In this frame, an optical absorption (OA) band centered at 7.6 eV has been observed both in irradiated silica and quartz and associated with a oxygen deficient center, called ODC(I), common in glass and crystal matrix [1]. Experimental and theoretical works evidenced that in silica the OA at 7.6 eV is able to excite a photoluminescence (PL) band at 4.4 eV through a conversion process of ODC(I) towards a different variant of oxygen deficient center, named ODC(II) [2, 3]. A corresponding emission process under excitation within the OA at 7.6 eV in quartz has not been clarified.

Here we report the investigation of PL activity in γ-irradiated (dose 1 Grad) α-quartz under vacuum-ultraviolet (UV) excitation by synchrotron radiation within the OA band at 7.6 eV, induced by irradiation. Two emissions centered at 4.9 eV (UV band) and 2.7 eV (blue band) are observed, both excitable within the OA band at 7.6 eV. The overall photoluminescence activity is detected only at low temperature, the UV band decreases above 40 K, whereas the blue band exhibits an initial slight increase and its quenching is effective above 100 K. Furthermore, the decay kinetics of both emissions occurs in a time scale of ns, at T=17 K we measured a lifetime τ=1.0 ns for the PL at 4.9 eV and τ=3.6 ns for the PL at 2.7 eV.

These results give new insight on the optical properties associated with defects peculiar of crystalline matrix, also on the basis of their comparison with previous studies on neutron irradiated quartz [4, 5].

[1] L. Skuja, J. Non-Crystalline Solids **239**, 16 (1998).

[2] D. Donadio, M. Bernasconi and M. Boero, Phys. Rev. Lett. **87**, 195504 (2001).

[3] S. Agnello, R. Boscaino, M. Cannas, F.M. Gelardi, M. Leone and B. Boizot, Phys. Rev. **B 67**, 033202 (2003).

[4] C.M.Gee, M. Kastner, J. Non-Crystalline Solids **40**, 577 (1980).

[5] A. Corazza, B. Crivelli, M. Martini, G. Spinolo, A. Vedda, Phys. Rev. **B 53**, 9739 (1996).