Vacuum ultraviolet excitation of the 4.4 eV emission band in neutron irradiated KU1 and KS4Vquartz glasses

LEON Monica *, MARTIN Piedad, VILA Rafael, MOLLA Joaquin, ROMAN Raquel and IBARRA Angel

Fusion Materials Research Unit, Euratom/CIEMAT Fusion Association,
CIEMAT , Avda. Complutense 22. (28040) Madrid . Spain

The photoluminescence induced by UV and vacuum ultraviolet (VUV) excitation, of neutron irradiated high purity silicas, with different OH contents have been studied. Quartz glasses KU1 (800 ppm OH) and KS4V (<0.1 ppm OH) are being considered as optical components in ITER [1, 2], due to their radiation hardness. Commercial silica Infrasil I301 (<8 ppm OH) from Heraeus, has been also studied for comparison. The neutron doses have been 10^{21} n/m^2 and 10^{22} n/m^2. It is well known that optical properties of silica are strongly influenced by defects induced by radiation [3] being optical absorption and photoluminescence spectroscopies techniques commonly used to characterize them.

Photoluminescence (PL) measurements have been made using synchrotron radiation (SR) in the excitation energy range from 4.5 to 8.8 eV and temperature from 300K to 10K. The SR source was the SUPERLUMI station of HASYLAB at DESY (Hamburg).

We will present the results on the emission band at 4.4 eV related to oxygen deficient centre ODC(II) [3] as a function of temperature and analysing the excitation spectra as a sum of elementary Gaussian bands.

The excitation spectra and the emission intensity at 4.4 eV are discussed as a function of the OH content, the temperature and the irradiation dose. Preliminary analysis of results indicate that photoluminescence emission, observed at 4.4 eV (282 nm), is produced by two VUV excitation bands around 6.8 eV (182 nm), 7.4 eV (167 nm) as well as an intense UV band at 5.0 eV (248 nm).

In all the samples, the intensity of the 7.4 eV band decreases with the temperature and it is not observed at 300K. An example of the measured excitations for KU1 irradiated at the higher dose, at two temperatures are shown in figure 1.

Bands around 6.8 eV and 5.0 eV are related to ODC(II) defect, and the 7.4 eV band is associated with the ODC(I) center. Discussion will include comparison with results obtained in ß irradiated silica with high OH content (Corning 7940) [4] and ? irradiated silica with low OH content (Suprasil 300) [5].

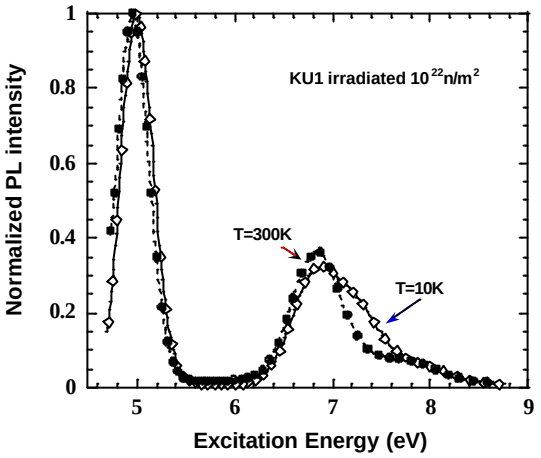

Fig.1: Normalized PL excitation spectra for neutron irradiated (dose 10^{22} n/m^2) KU1 quartz glass, at 10K and 300K.

References

[1] M. Decreton, T. Shikama and E. Hodgson, J. Nucl. Mat. 329-333 (2004) 125-132

[2] K.Yu Vukolov, B.A. Levin, Fus. Eng. Design 66-68 (2003) 861-864

[3] L. Skuja, M. Hirano, H.Hosono and K. Kajihara, Phys. Stat. Sol. (c), 2 (2005) 15-24.

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

[5] R.Boscaino M. Cannas, F.M. Gelardi, M. Leone, J.Phys:Condens. Matter. 11 (1999) 721-731

---

* Corresponding Author: monica.leon@ciemat.es
Materiales para Fusión
CIEMAT
Avda. Complutense 22
28040 Madrid (Spain)