Laboratoire des Solides Irradiés, UMR 7642

Séminaire Invité

Linards SKUJA

Chercheur

Institute of Solid State Physics, University of Latvia

Mardi 18 octobre 2016 – 14h15

Salle 2034 - – Bâtiment 83 – 1ER étage

14h

The role of interstitial molecules in radiation processes in SiO_2.

Synthetic high purity glassy silicon dioxide (g-SiO_2) is important material in applications using optical fibers, high-power laser optics, radiation-resistant and UV transmitting elements. The operation of these devices is adversely affected by creation of point defects. Their formation mechanism in g-SiO2 is often different from mechanisms, typically taking place in crystalline materials or multicomponent glasses. Instead of electron/hole trapping on preexisting precursors, the majority of radiation-induced defects in g-SiO_2 is created in photochemical reactions, involving monovalent impurities (mostly hydrogen) and interstitial gas molecules.

The talk will give a brief overview of the properties of different gas molecules observed in g-SiO_2 (H_2, O_2, O_3, H_2O, HCl, Cl_2), their spectroscopic properties and their impact on radiation toughness of g-SiO_2 optical devices. More details will be given on interstitial oxygen and chlorine molecules and our recent studies of these species will be discussed.

Interstitial oxygen atom, possibly in the form of Si-O-O-Si peroxy linkage, has not been experimentally observed in SiO_2. On the other hand, its dimerized form, interstitial O_2 molecule, can be monitored by its distinct IR luminescence. By using it, the defect formation and isotope exchange between of O_2 and SiO_2 network was studied.

Apart from intrinsic radiation effects, optical properties of synthetic SiO_2 are often affected by the presence of chlorine impurities left from the synthesis process. We have recently proved that interstitial Cl_2 molecules in g-SiO_2 show characteristic near-IR luminescence, which can be excellently used for detection of their presence and for studying their photo- or radiation-induced -reactions in g-SiO_2. The present data indicate that Cl_2 molecule is strongly stabilized against dissociation by SiO_2 glass matric ("cage effect").