Deep understanding of advanced optical and dielectric materials for fusion diagnostic applications

Anatoli I. Popov[1], Eugene A. Kotomin[1], Vladimir Kuzovkov[1], Aleksandr Lushchik[2], Aleksandr Platonenko[1], Eugene Shablonin[2], V. Seeman[2], Theo A. Scherer[3]
[1]Institute of Solid State Physics, University of Latvia, Kengaraga 8, Riga LV-1063, Latvia
[2]Institute of Physics, University of Tartu, W. Ostwald Str. 1, 50411 Tartu, Estonia
[3]Karlsruher Institut für Technologie (KIT), D-76344 Eggenstein-Leopoldshafen, Germany

The industrial progress of 21st century could greatly benefit from development and exploitation of fusion reactors producing environmentally clean friendly electrical energy. One of a key problem here is need in new advanced materials able to operate under extreme conditions (high temperatures and intensive neutron/gamma radiation). Search for such optical and dielectric materials is an essential part of EUROfusion-Latvia association activities. In this talk, I will give short overview of the most interesting results obtained in the framework two EUROfusion Enabling Research Project - "Advanced experimental and theoretical analysis of defect evolution and structural disordering in optical and dielectric materials for fusion applications (AETA)" (2019-2020) and "Investigation of defects and disorder in nonirradiated and irradiated Doped Diamond and Related Materials for fusion diagnostic applications (DDRM) – Theoretical and Experimental analysis " (2021-2023).

In a series of joint works by ISSP UL (Latvia), UT (Estonia) and KIT (Germany), radiation damage of some promising functional materials from the EUROfusion consortium priority list was studied under neutron, proton, heavy ion and gamma irradiation.

The optical, dielectric, vibrational and magnetic properties of numerous crystalline and ceramic materials were carefully studied.

Based on this study, we developed new theoretical methods able to evaluate and predict advanced materials functionality and radiation damage evolution under extreme conditions [1-4]

References

[1] Lushchik A., Feldbach E., Kotomin E.A., Kudryavtseva I., Kuzovkov V.N., Popov A.I., Seeman V., Shablonin E. (2020) Scientific Reports, 10 (1) , art. no. 7810
[2] Seeman V., Lushchik A., Shablonin E., Prieditis G., Gryaznov D., Platonenko A., Kotomin E.A., Popov A.I. (2020) Scientific Reports, 10 (1) , art. no. 15852
[3] Lushchik A., Kuzovkov V.N., Kotomin E.A., Prieditis G., Seeman V., Shablonin E., Vasil'chenko E., Popov A.I. (2021) Scientific Reports, 11 (1) , art. no. 20909
[4] Shablonin E., Popov A.I., Prieditis G., Vasil'chenko E., Lushchik A. (2021) Journal of Nuclear Materials, 543 , art. no. 152600