



## Seminarium Zakładu Energetyki Jądrowej i Analiz Środowiska (UZ3) Departament Badań Układów Złożonych (DUZ)

Wtorek: **07.03.2023**

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<https://www.gotomeet.me/NCBJmeetings/uz3-and-phd4gen-seminars>

### Zuzanna Krajewska

#### **TRISO - the coated particle nuclear fuel. New insights into experimental and computational research**

##### **Abstract:**

The TRIstructural ISOtropic (TRISO) fuel, composed of uranium kernel covered with silicon carbide and pyrolytic carbon coating layers, serves as the smallest component of the nuclear fuel. Thousands of the TRISO-particles are immersed in the graphite matrix, taking the form of a sphere (pebble bed reactor type) or pellet (prismatic reactor type), which are mainly used in the High-Temperature Gas-cooled Reactors (HTGRs). Due to the fuel irradiation in the reactor core, partial or complete damage of the covering TRISO layers might occur. The examination of the defects occurring in the TRISO layers is a key aspect of a good understanding of the failure-free performance of TRISO-particle fuel and is key to the safe and efficient operation of the HTGR reactors. A large knowledge and modelling base exists on the behaviour of TRISO-coated particles under irradiation as well as under accident conditions, and numerous benchmarking exercises comparing experimental results and calculations on TRISO failures show that failure mechanisms are rather well understood. Nevertheless, the characterization of the TRISO coating layers at the interface between the two main layers – the low-density porous pyrocarbon - Buffer and high-density inner pyrolytic carbon IPyC - remains an issue. Understanding the characteristics of the TRISO coating layers at the joint surface is very important because a potential coating failure of TRISO particles during irradiation can be caused by cracking of the IPyC layer due to densification of the Buffer layer when it is strongly bonded to the IPyC layer. Consequently, cracks in the IPyC layer may eventually lead to the attack of fission products on the following layers. The presentation will share new insight into the TRISO-particle investigations, performed by experimental and computational research. For the experimental part, the results obtained by tools like ion implantation (as a surrogate for neutron irradiation-induced damages), Raman spectroscopy (to measure the defects), and Scanning Electron Microscopy SEM (to visualize the irradiated structure) will be presented. In addition, current work with the use of the LAMMPS (microstructural analysis of the ion irradiation-induced defects) and BISON (gap formation between Buffer-IPyC interface) codes will be presented..

Serdecznie zapraszamy

Mariusz Dąbrowski, Tomasz Kwiatkowski

<http://www.phd4gen.pl>

**Bio:**

**Zuzanna Krajewska** is a PhD Student at National Centre for Nuclear Research. During her PhD she performed several experiments on the TRISO particle nuclear fuel. Currently, she is an Intern at Idaho National Laboratory, where she combines her experimental and computational experience performing simulations with the use of a BISON code.