Innovative Sensors for Material Ageing and Radiation Testing Project

Prepared by Igor Królikowski (KIC PhD Student) - igor@agh.edu.pl, Supervisor: Prof. Jerzy Cetnar - cetnar@mail.ftj.agh.edu.pl
Chair of Nuclear Energy Engineering, Faculty of Energy and Fuels
AGH University of Science and Technology in Cracow

OBJECTIVES OF KIC PROJECT

Advanced methods of measurement

Nuclear instrumentation is still based mainly on safe, efficient but conservative technologies. Present and future competitiveness goes through the optimization of accurate and predictive knowledge of nuclear reactor behavior and radiation monitoring in nuclear media. Advanced instrumentation and measurement methods are also the key to competitiveness and added value of innovation technologies.

New SiC sensors

Selective and simultaneous – „spectroscopic" - detection of both fast and thermal neutron fluxes as well as gamma radiation operating at elevated temperatures is by now a real instrumentation challenge for nuclear power industries in terms of direct (on-line) nuclear ageing and fuel cycle monitoring.

Large technological breakthrough gives opportunity to design and implement high performances sensors in a very harsh environment such as occurs in the reactor core.

Future reactors will need a complete new generation of on-line instrumentation and innovative advanced measurement methodologies.

Nuclear simulation tools

Due to a huge progress of the simulation science, the experimental benchmarks have to be more instrumented than in the past, especially concerning real-time analysis devices. The simulation tools allow to optimize and improve the operation of reactors.

EXPECTED RESULTS

- **Advanced Silicon Carbide developement and adaptation to nuclear measurement harsh conditions.**
- **Surely at least 2-3 patents linked to detector/ sensor, front-end electronics, electronic hardening.**
- **Enhancement of performances, progress in scientific and technological knowledges, new fields for Si-C applications.**

PhD TASK IN KIC I_SMART PROJECT

The modeling of neutron and gamma radiation interaction with matter, which leads to the signal formation in SiC sensors is the main area of research for the PhD position. The research will include further development and validation of nuclear simulation tools of radiation transport and nuclear transmutation in application to SiC modeling.

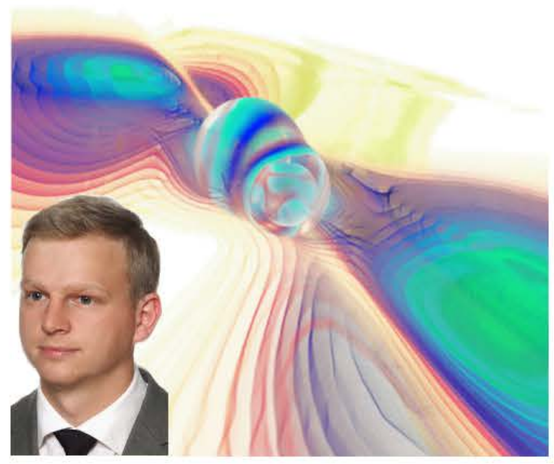

Photo: Igor Królikowski (PhD Student responsible for above task)

PROJECT IMPACT

The fundamental impact of the project is to enhance safety of nuclear power installations and as such to strengthen the use and development of the nuclear power business in Europe and worldwide.

SAFETY

The nuclear safety will be reinforced using on-line instrumentation and accurate associated measurement methods.

OPTIMIZATION & ECONOMICAL IMPACT

A more efficient instrumentation will allow for optimizing of the reactor operation, efficiency and lifetime duration, thus in consequence will positively impact on the operation costs.

COMPETITIVENESS

The nuclear energy production competitiveness may be significantly enhanced providing more accurate monitoring of the present and future nuclear fission reactors and nuclear fuel facilities.

INNOVATION

The implementation of the R&D and innovation results of the project is considered for both exisitng and new business processes

Impact on existing business processes

On-line selective and simultaneous detection of both fast and thermal neutron flux and high energy gamma flux is the real instrumentation and measurement challenge mainly for:

- -Nuclear experimental and power reactor
- -Nuclear fuel cycle
- -Safeguards
- -Homeland security
- -BNCT (Boron Neutron Capture Therapy)

Impact on new business processes

To the best of our knowledge, there is no system available for radiation monitoring at elevated temperatures (up to 600 °C) and the timing for launching a focused I_SMART European project toward solving this problem is excellent in terms of actuality, possible impact on conquering new market and relative readiness of silicon carbide (SiC) technology.

I_SMART Project Participants