

NOMATEN SEMINAR

<https://www.gotomeet.me/NCBJmeetings/nomaten-seminar>

Tuesday, MARCH 15th 2022 13:00 (1.00PM CET)

Fusion energy materials: the challenges for clean and abundant energy production

Konstantina Mergia. National Centre for Scientific Research "Demokritos", Athens, Greece

kmergia@ipta.demokritos.gr

Abstract:

Fusion, the nuclear reaction that powers the Sun and the stars, is a potential source of safe, abundant, and carbon-free energy with almost no environmental impact. In Europe, the road to fusion energy focusses on using magnetically confined plasmas at temperatures above 100 million degrees Celsius and with long enough duration for commercial use. Although, in laboratory settings, hot plasmas at these temperatures are routinely confined by strong magnetic fields, challenges remain in creating the right conditions for generating fusion energy on Earth.

One of the main challenges for realizing fusion electricity is the development of advanced materials capable to withstand high heat loads and the radiation fields of highly energetic neutrons and charged particles for long periods while retaining adequate physical and mechanical properties. Fast neutrons initiate collision cascades in which radiation defects are formed. These defects migrate, react, coalesce, and grow. In addition to the displacement damage, the high energy neutrons in a fusion spectrum produce transmutation products in the components surrounding the plasma with generation rates that can be orders of magnitude higher than that in fission-based Material Test Reactors. This can substantially accelerate radiation embrittlement, depending on temperature and deformation rate, and promote early degradation and failure.

The fusion energy materials span a large spectrum of materials ranging from structural materials, plasma facing materials and functional materials. The structural materials refer mainly to reduced activation ferritic/martensitic alloys based on Fe-Cr alloys which are candidate materials for the future fusion energy reactor. The plasma facing materials refer to tungsten and beryllium based materials which are also candidates for the fusion devices that are either under construction (ITER) or comprise the next step in the European Fusion Roadmap. Key aspects of fusion material challenges in the field of plasma facing materials and structural materials will be presented.

Examples of the response of irradiated fusion materials to macroscopic engineering variables as the operating temperature, irradiation dose and irradiation dose rate will be discussed.

Bio:

Konstantina Mergia, BSc and PhD in Physics, is Research Director at the Institute of Nuclear and Radiological Science and Technology, Energy and Safety at the National Centre for Scientific Research “Demokritos” (NCSR), Athens, Greece. She is coordinator of the Fusion Technology Programme at “Demokritos” consisting of fifteen researchers, and European projects on fusion and aerospace materials. She is collaborator of many European Research Centres, Universities and Industry. She carries out research on structural, plasma facing and functional materials, radiation damage, phase transformations and transport phenomena, ceramic-metal interactions, oxidization phenomena, material engineering (porosity, internal stresses, oxidation barriers, materials joining) and magnetic materials. She has developed extensive laboratory facilities on a) structural characterization of materials from nano- to macro-scale, b) mechanical properties, c) defects in materials, d) electrical properties of materials, e) material fabrication and processing and f) metallography.

Personal website: <https://ftg.demokritos.gr/people/38>

Email: kmergia@ipta.demokritos.gr