

NOMATEN Seminar

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Multiscale constitutive modeling of irradiation effect on mechanical properties of metals

Aneta Ustrzycka PhD

**Institute of Fundamental Technological Research, Polish Academy of Science (PAN)
Instytut Podstawowych Problemów Techniki Polskiej Akademii Nauk**

Abstract:

During irradiation, energetic particles such as protons, neutrons, light and heavy ions introduce significant microstructural defects in materials. The nature of damage in irradiated materials is mostly associated with the formation, distribution and interaction of point defects, vacancies and interstitials and their clusters. Materials subjected to high dose irradiation by energetic particles often experience severe damage in the form of significant degradation of their mechanical and physical properties. Understanding the mechanisms of radiation damage has a significant impact on the design of radiation tolerant materials.

The main objective is predicting evolution of radiation induced damage in the solids subjected to mechanical loads. The evolution of radiation induced damage is combined with the evolution of mechanically induced damage within the common framework of Continuum Damage Mechanics (CDM). Multiscale constitutive model containing strong physical background related to the mechanism of generation of radiation induced defects in solids is built. As an application, estimation of lifetime of a magnetic horn (coaxial target embedded in a detector of particles) subjected to combination of irradiation and mechanical loads, has been carried out. The model is based on the experimental results.

Moreover, the novel approach based on a new theory peridynamics is proposed to build a nonlocal model for irradiated materials that capture more physical features.

Bio Note:

She graduated Physics Faculty at Warsaw University. She obtained PhD in solid mechanics in 2012 at Cracow University of Technology. Currently, she is employed at Institute of Fundamental Technological Research, Polish Academy of Science. Before taking up her current position, she was an Assistant Professor at the Cracow University of Technology.

Her scientific research is focused on constitutive modeling material behaviour subjected to extreme conditions: radiation, various mechanical loading and extreme temperatures. In particular, she concentrates on the various aspects of damage and fracture mechanics, physics and mechanics of radiation-induced defects and singularities.