



**Faculty of Materials
Science and Engineering**

WARSAW UNIVERSITY OF TECHNOLOGY

Activities of FMSE WUT in the European Fusion Research Programme – EUROfusion Tasks

Łukasz Ciupiński, Ph.D.

**Warsaw University
of Technology**



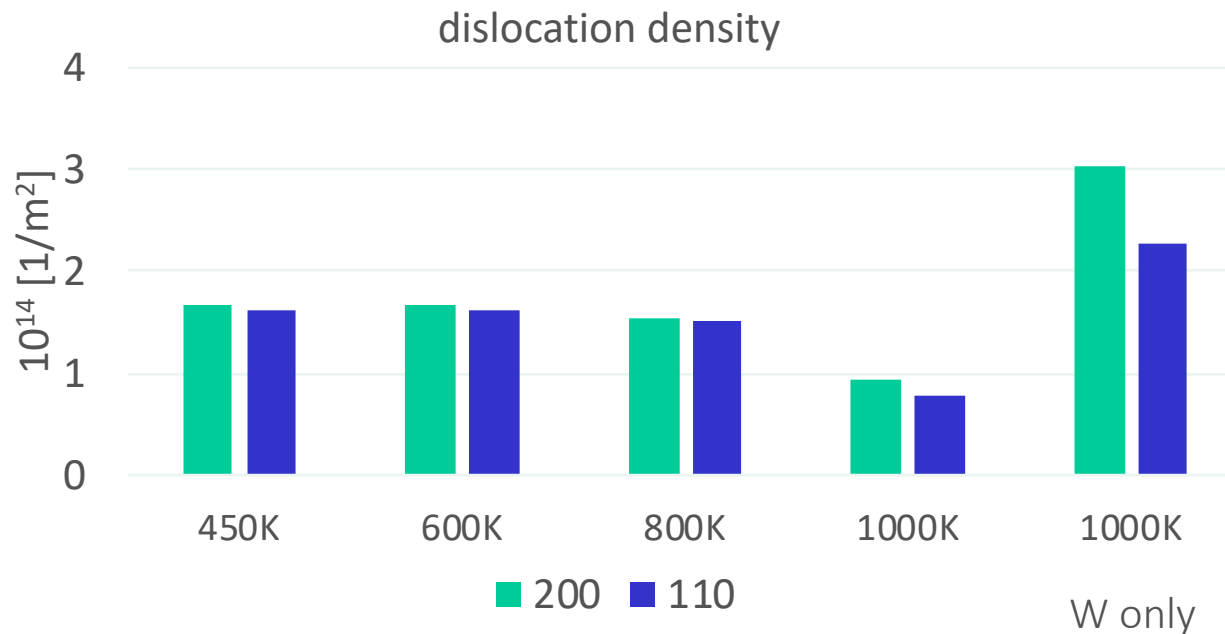
2018 Tasks under EUROfusion contract

1. WPJET2 - Analysis of JET ITER-like wall plasma facing components
2. WPPFC - Preparation of efficient PFC exploitation of ITER and DEMO
3. WPPMI Plant level system engineering, design integration and physics integration
4. WPMAT - IREMEV Integrated Radiation Effects Modelling and Experimental Validation
5. WPMAT - FM Functional Materials
6. WPENS - Early Neutron Source definition and design



PFC.SP3.1: Role of neutron damage on retention mechanisms and strength in W / Be - TEM analysis of W samples after simultaneous damaging and loading

3



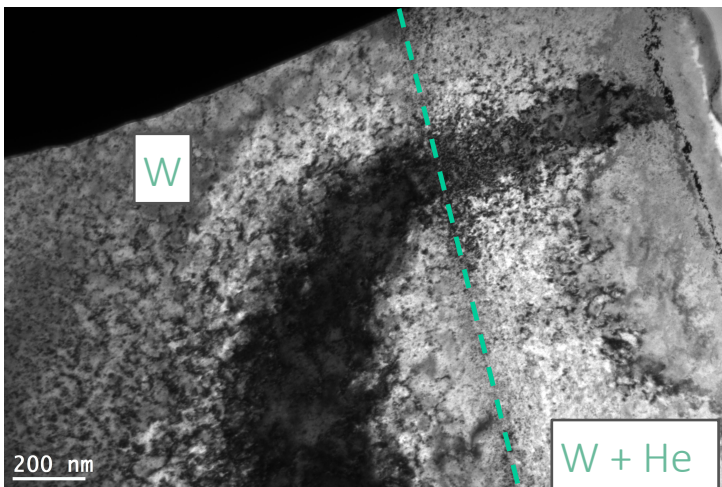
- Goals:
- To closer simulate Fusion Reactor relevant conditions
- To evaluate the influence of damage production parameters on evolving defects structure

Collaboration:
IPP Garching and JSI
Ljubljana

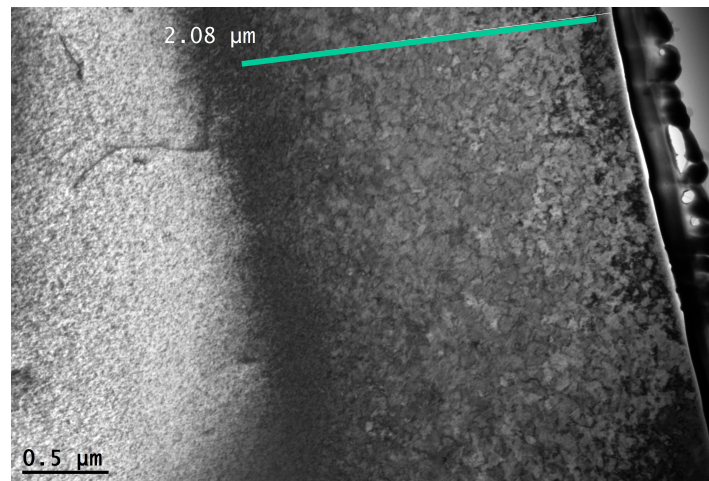
PFC.SP3.3: Role of seeding impurities on fuel retention and removal techniques - TEM analysis of self-damaged W samples with He implanted into the bulk



W +He irradiated



W irradiated



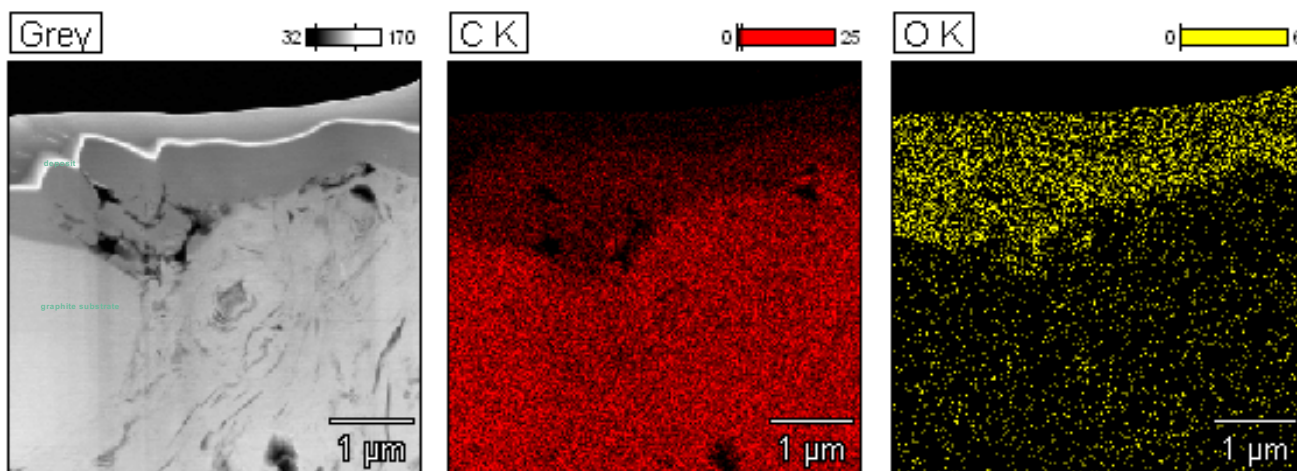
TEM images of W / He irradiated samples

- Goals:
- - To assess the influence of He implanted into the pre-damaged and D-loaded tungsten targets on D retention
- To describe the defects nature & morphology

Collaboration:
IPP Garching

PFC.SP5.1: Material migration in tokamaks - Investigations of AUG marker samples and W7-X limiter tiles

5

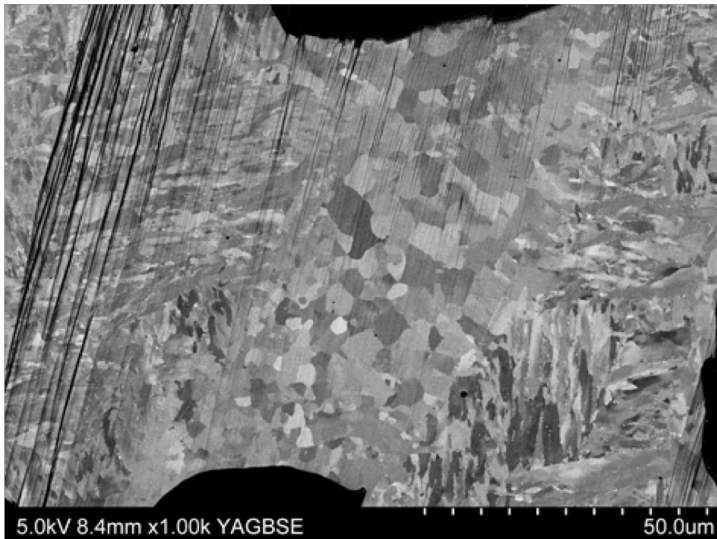


Mapping of oxygen and carbon distribution.

- Goals:
- to study of the plasma-surface interaction in a stellarator
- to characterise the tiles after first operational campaign in W7-X

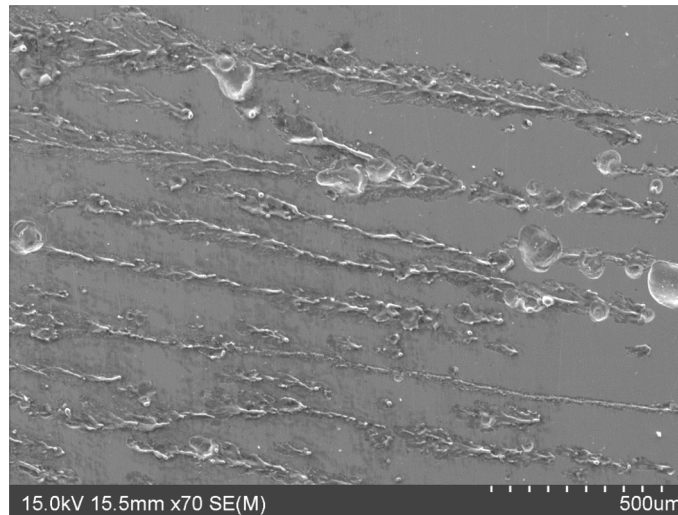
PFC.SP5.7: Characterization and modelling of metallic dust remobilization, melting and vaporization - Microscopy studies of W / P92 steel samples originating from the 2017 campaign on AUG

6



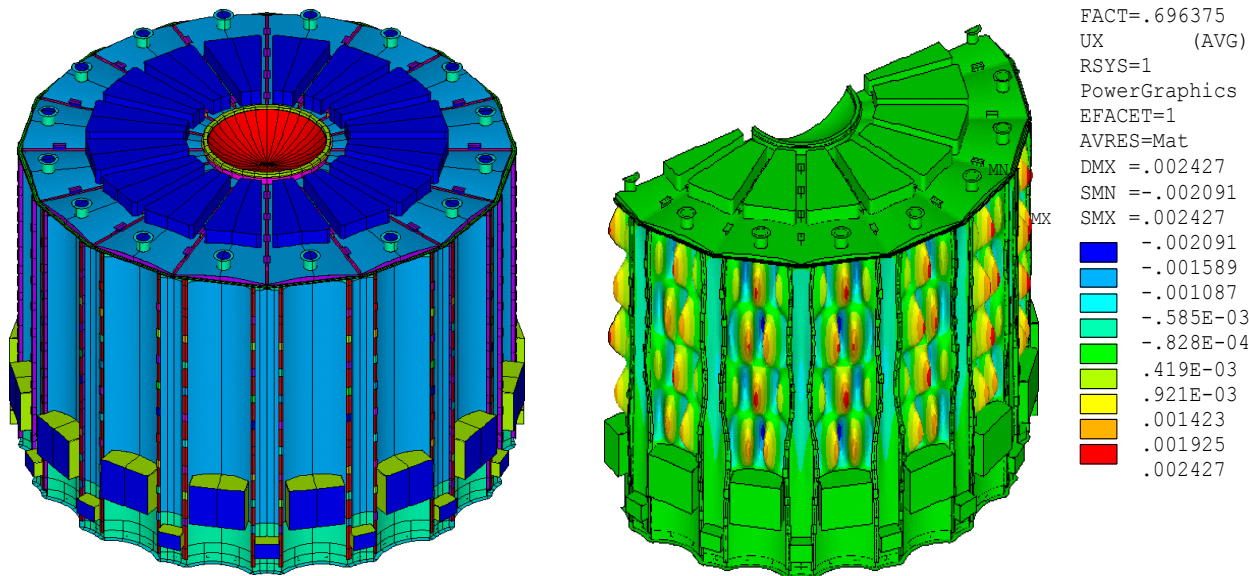
SEM image of the region between two craters

SEM image of the P92 surface



- Goals:
- to investigate the potential of use of bare steel as plasma facing material
- to characterise P92 ferritic-martensitic steel installed at the divertor region in ASDEX Upgrade

WPPMI Plant level system engineering, design integration and physics integration - Structural design assessment of the DEMO cryostat

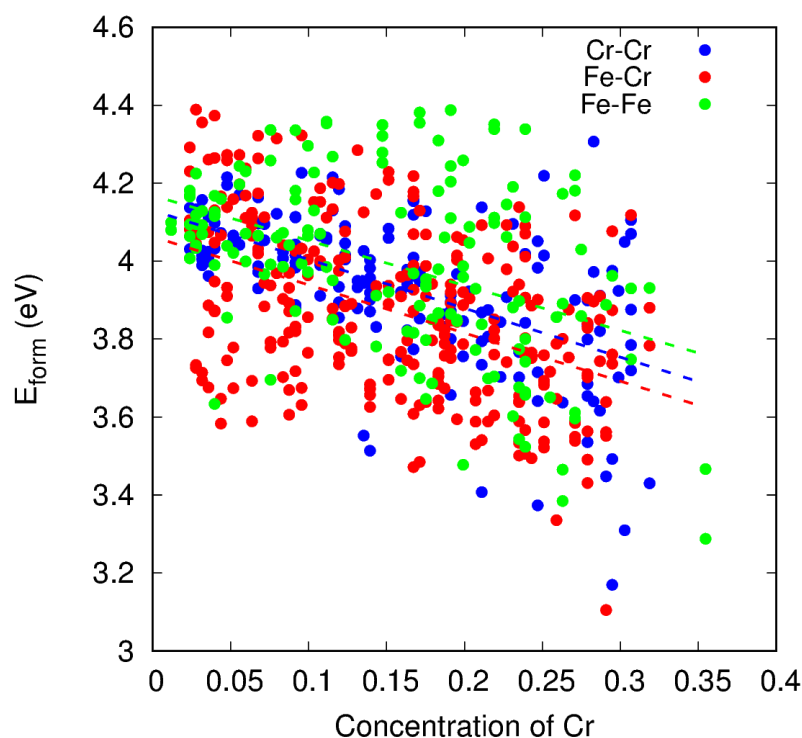


CAD model and buckling FEM analyses results of DEMO cryostat

- Goals:
- - To develop DEMO cryostat design
- To verify the structure integrity and stability under relevant loading conditions

Collaboration:
PPPT EUROfusion

WPMAT – IREMEV Integrated Radiation Effects Modelling and Experimental Validation - Fluctuations of interstitial and C15 configurations in concentrated Fe-Cr alloys from first principles



Formation energies of Cr-Cr, Fe-Cr and Fe-Fe dumbbells in Fe-Cr alloys.

- Goals:
- to understand (using first principles method) how the properties of interstitials change with the increase of Cr content
- what is the reason of the properties fluctuations

Collaboration:
CCFE Culham

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Ł. Ciupiński, IFJ – Kraków, 26.11.2018

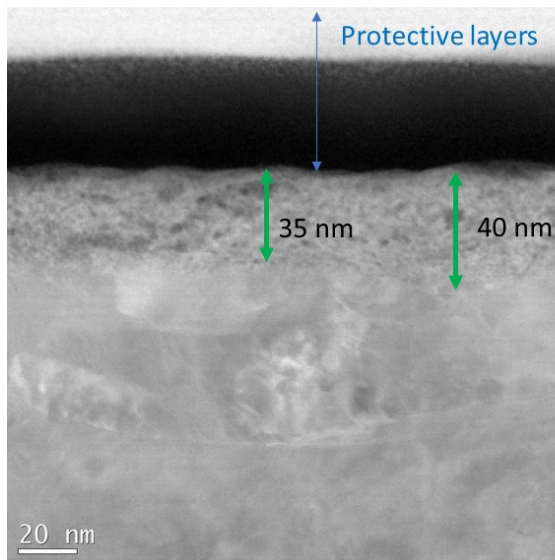
WPMAT – Functional Materials - Irradiation Testing of mirrors: Microscopy Studies of Surface



Cross sections after irradiation

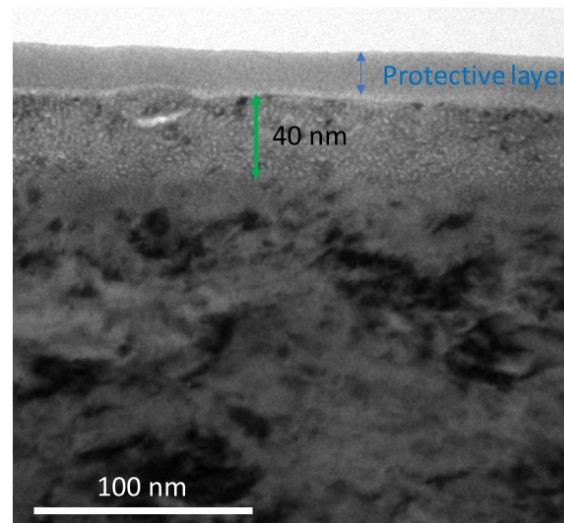
after irradiation with Mo and He ions

STEM HD 2700 Z-contrast mode



after irradiation with Nb and He ions

TEM JEOL 1200



Goals;

- Electron microscopy investigations to determine microstructure changes in Mo mirrors resulting from irradiation.
- Correlate microstructural changes with reflectivity measurements

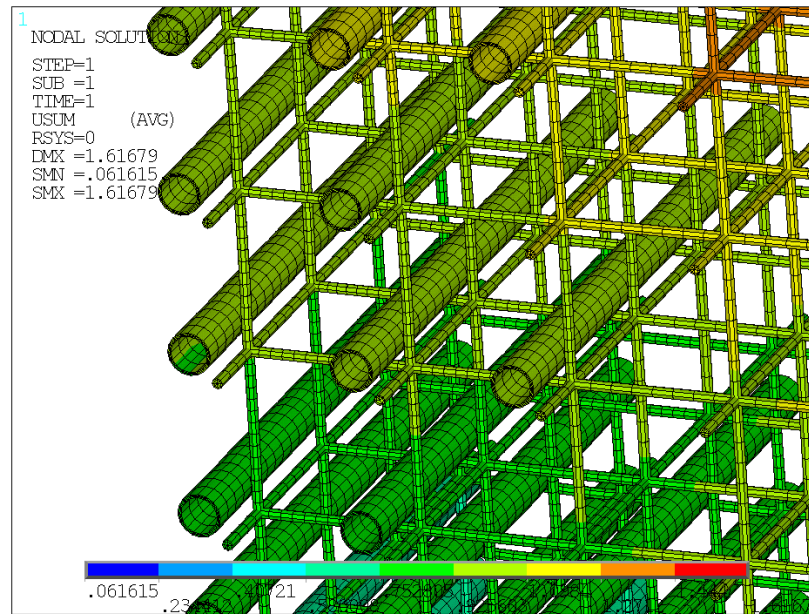
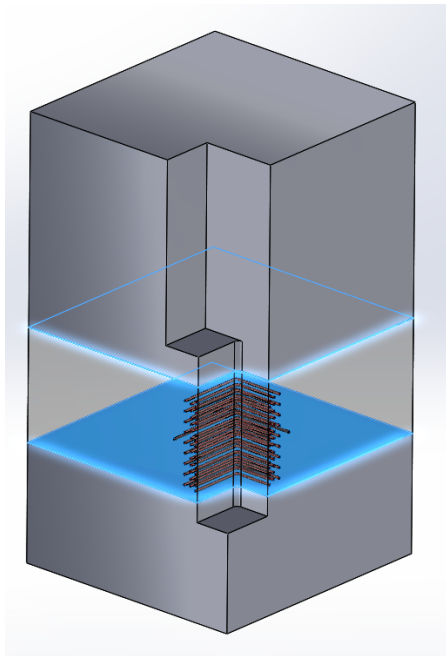
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Collaboration:
KTH Stockholm

Ł. Ciupiński, IFJ – Kraków, 26.11.2018

WPENS - Early Neutron Source definition and design - Contribution to upgrade of preliminary engineering design of TC

10



FEM model of rebar and cooling pipes

- Goals:
- to design and optimise cooling system of the IFMIF-DONES test cell biological shield
- to assess the thermo-mechanical behaviour response of the structure under full power operation

Collaboration:
KIT, Karlsruhe

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Thank you for your kind attention !

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