

## The European Roadmap for materials – progress and key challenges ahead

G. Pintsuk<sup>1,\*</sup>, G. Aiello<sup>2</sup>, S.L. Dudarev<sup>3</sup>, J. Henry<sup>4</sup>, M. Rieth<sup>5</sup>, D. Terentyev<sup>6</sup>, R. Vila<sup>7</sup>, M. Wirtz<sup>1</sup>

<sup>1</sup>*Forschungszentrum Jülich GmbH, Institut für Energie- und Klimaforschung – Plasmaphysik, Partner of the Trilateral Euregio Cluster (TEC), 52425 Jülich, Germany*

<sup>2</sup>*EUROfusion Consortium, Programme Management Unit, 85748 Garching, Germany*

<sup>3</sup>*Culham Centre for Fusion Energy, UK Atomic Energy Authority, Culham Science Centre, Oxfordshire, OX14 3DB, UK*

<sup>4</sup>*Université Paris-Saclay, CEA, Service de Recherches Métallurgiques Appliquées, 91191, Gif-sur-Yvette, France*

<sup>5</sup>*Karlsruhe Institute of Technology, Institute for Applied Materials, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany*

<sup>6</sup>*Belgian Nuclear Research Centre, SCK•CEN, Mol, 2400, Belgium*

<sup>7</sup>*CIEMAT-Fusion Association, Avenida Complutense 40, 28040 Madrid, Spain*

The EUROfusion materials research program for DEMO in-vessel components aligns with Mission 3 of the European Fusion Roadmap and comprises on the one hand the qualification of the in-vessel baseline materials EUROFER97, CuCrZr and tungsten. On the other hand, advanced structural and high heat flux materials are developed for risk mitigation. Also, optical and dielectric functional materials are characterized for various applications in diagnostics, heat and current drive systems, and as insulators. The focus is primarily on assembling the qualified data to support the design process and generate material property handbooks, material assessment reports, design criteria and material design limits for thermal, mechanical and environmental DEMO conditions. In particular, these include high fluence neutron irradiation effects on the involved materials and components.

Besides the actual status of the qualification program on baseline materials, progress highlights are provided on advanced material development, including an assessment of the materials readiness, as well as the theoretical understanding and simulation of neutron effects on material microstructure and properties as a function of operating conditions. The latter represents the mitigation action with regard to one of the key challenges ahead, which is the experimental assessment of the material properties in a still to be built facility like IFMIF-DONES as well as the system integrated material performance under fusion neutron irradiation / operational conditions.

An outlook on future material development, qualification and simulation activities and challenges during the actually running Conceptual Design Phase as well as the subsequent Engineering Design Phase for DEMO will be provided.

**\*Corresponding author:** E-mail: [g.pintsuk@fz-juelich.de](mailto:g.pintsuk@fz-juelich.de)