

Application of field-assisted sintering for diffusion joining of tungsten-based SMART alloys to Eurofer steel for future fusion reactors.

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Robust joints between plasma facing material and the blanket structure are crucial for fusion reactors. This work studies the diffusion joining of W-11.4Cr-0.6Y-0.4Zr (also known as SMART alloy) to the structural material Eurofer steel using FAST/SPS. SMART alloys, - due to their self-passivating properties in oxidizing environments - are promising candidates for reactor walls and they are manufactured by mechanical alloying followed by consolidation using field-assisted sintering (FAST/SPS). However, joining SMART to steel is challenging due to mismatch in coefficients of thermal expansion between tungsten and steel.

FAST/SPS joining of SMART and Eurofer at temperature $\geq 950^\circ\text{C}$, pressure of 50 Mpa, heating rate of 200 K/min and dwell time ≤ 10 min produces a metallurgical bond with a distinct interdiffusion zone, while joining at temperature $\leq 950^\circ\text{C}$ results in minimal reaction. Results of EDX characterization and the presence of pores in the intermetallic layer formed at the bond seam indicate a vacancy driven solid-state diffusion, dominating in the direction of SMART to Eurofer. In addition to the bonding interface, the microstructures of SMART and Eurofer before and after joining are characterized, providing a baseline for subsequent tempering at 760°C . Such a post-bonding heat treatment should help retrieving the microstructure and mechanical properties of Eurofer. Future work for the qualification of joints includes high heat flux tests and mechanical strength tests.

Professional Status of the Speaker

Doctoral or Master Student

Interest in submitting a paper in a special issue of

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Invitation letter for visa

No

Author: Ms BINU VARGHESE, Aparna (Forschungszentrum Jülich)

Co-authors: Dr CHEN, Jie (Forschungszentrum Jülich); Dr COENEN, Jan Willem (Forschungszentrum Jülich); Prof. LINSMEIER, Christian (Forschungszentrum Jülich); Dr LITNOVSKY, Andrey (Forschungszentrum Jülich); Prof. BRAM, Martin (Forschungszentrum Jülich)

Presenter: Ms BINU VARGHESE, Aparna (Forschungszentrum Jülich)

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