Thermomechanical Characterization of Joints for Blanket and Divertor Application Processed by Electrochemical Plating

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Motivation

Fusion technology requires in the fields of first wall and divertor development reliable and adjusted joining processes of plasma facing tungsten to heat sinks or blanket structures. Electroplating has the feature to generate layers acting as active interlayers and as brazing alloys which can overcome such lacks. This work was performed to demonstrate that the electrochemical plating tool can be used for fusion relevant alloy combinations.

The joints were qualified by thermomechanical testing for the demonstration of future applicability in fusion development.

Joints processed by electroplating

The development of joining technology by electroplating consists of the two main parts:
- Electroplating
- Joining by brazing or bonding
Interlayers may be Ni, Pd, Cr or Fe to improve reactions. Electroplating from aqueous electrolytes similar to the filler Cu is expected to be effective in obtaining materials in contact zone of filler to base material.

Mechanical characterization of samples

Impact of testing temperature and aging on joints

Mechanical behavior vs. testing conditions and temperature

The investigations showed that electroplating is an effective technology in the field of the joining of fusion relevant materials and components for divertor and blanket development.

- Reactive Ni and Pd layers were successfully deposited on tungsten, Eurofer and stainless steel by electroplating to obtain improved brazing by Cu
- Mechanical testing was performed in the temperature range RT to 600°C
- Shear strength decreases with temperature similar to yield strength of Cu
- Aging at 700°C showed diffusion in brazing zone but no significant weakening
- At 450°C and 600°C failure appeared as expected in the braze for all joints tested
- Higher strength of joints with Pd interlayer observed

Conclusions

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