FUSION FOR ENERGY

TECHNOLOGY OFFER

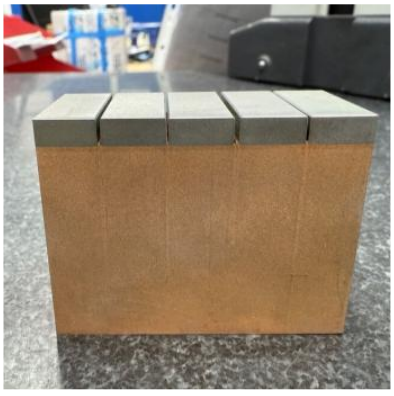


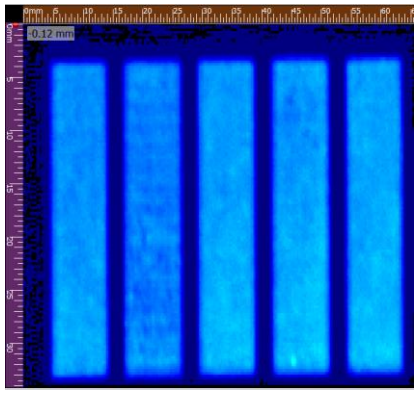
Diffusion Bonding of Tungsten Armour to Copper-Alloy Heat Sinks

Through its collaboration with Fusion for Energy (F4E), RTC Engineering has developed and qualified a solid-state diffusion-bonding process for joining tungsten armour tiles to CuCrZr heat sinks. The process addresses the challenge of creating reliable metallurgical joints between dissimilar materials exposed to high thermal loads, combining the heat resistance of tungsten with the thermal conductivity of copper alloys.

The technology

The process bonds high-purity tungsten armour to a CuCrZr heat-sink body through a 1 mm oxygen-free copper (Cu-OFE) interlayer. Bonding is performed under an inert argon atmosphere using a controlled thermal and pressure cycle.Key parameters, including temperature, pressure, processing time, heating, and cooling, are fully monitored and recorded. The resulting joint is verified through ultrasonic non-destructive testing to confirm bond integrity and detect possible defects.





Tungsten armour tiles diffusion-bonded to a CuCrZr heat-sink body (left), with the corresponding ultrasonic inspection (right) confirming a sound bond with no detectable indications.

Advantages and Potential Applications

- Reliable and reproducible bonding between refractory metals and copper alloys.
- Controlled production process with full component traceability and acceptance documentation.
- Post-bond ultrasonic inspection according to recognised EN ISO standards.
- Suitable for high-heat-flux components such as fusion first walls and divertors.
- Transferable to aerospace, power-electronics cooling, Big Science facilities, and other applications requiring robust refractory-metal-to-copper joints.

Collaboration opportunities

RTC Engineering offers this diffusion-bonding capability to companies and research institutions requiring reliable tungsten-to-copper or other refractory-metal-to-copper joints. The company can manufacture bonded components, assess the feasibility of new material combinations, and adapt and validate the process for specific industrial or scientific applications.

Fusion for Energy Technology Transfer Programme

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