



Contribution ID: 1150

Type: **not specified**

## **P3.103 Manufacturing and characterization of stainless steel / CuCrZr and stainless steel / Cu transition ring by explosive welding method**

*Wednesday, 19 September 2018 11:00 (2 hours)*

Actively cooled plasma facing components (PFC) are often made of CuCrZr, whereas the cooling pipes are made of stainless steel. Both materials are not easily joined, and a common solution is electron beam welding, using a ring made of Inconel or Ni as intermediate.

This paper reveals the potential of using explosive welding as an alternative joining technique for multi-material transitions of CuCrZr/stainless-steel. Two plates of 16mm thickness were assembled by explosive method. Then rings (13.7mm outer diameter, 10.4mm inner diameter) were machined out from this assembly. These rings were finally welded onto the PFC (CuCrZr) by electron beam and on the cooling pipe (stainless steel) by TIG welding.

Thermo-mechanical simulations were done to determine the stress level around the joint, for a typical WEST PFC and different scenarios (baking and normal operations in WEST). A design load case was then determined. Afterwards, mechanical tests were carried out on relevant sample geometry for a significant stress level. Tensile tests were done at both room temperature and 200°C to determine the ultimate tensile strength and the maximal elongation. Rotative bending fatigue tests were also done to ensure that the CuCrZr / steel joint had a sufficient lifetime regarding the expected operation. The quality of the sealing was also tested with He leak testing procedure at high temperature.

Finally, a second type of ring made of Cu / steel was also considered. It is shown that due to the explosive process, Cu is largely hardened, and thus also suitable as structural material. Moreover, welding of Cu on CuCrZr is more reliable than CuCrZr on CuCrZr, making this solution even more appropriate.

The paper concludes on the adequacy of using explosive welding for multi-material transitions of CuCrZr or Cu and stainless-steel, for linking a CuCrZr PFC to a stainless steel cooling pipe.

**Presenter:** Dr FIRDAOUSS, Mehdi (IRFM CEA)

**Session Classification:** P3