Introduction: The ITER divertor system aims to exhaust a significant part of the plasma power and to minimize the helium and impurity content in the plasma. The Inner Vertical Target (IVT), to be delivered by European domestic agency, is constituted of Carbon Fibre Composite (CFC) monoblocks in the lower part and tungsten (W) monoblocks in the upper part. The CFC armour material must have some technical and non-technical requirements. CFC must have high mechanical and thermal properties fitting to the PFC manufacturing process (joining CFC to a CuCrZr tube) and to the inspection requirements (detecting defect at CFC to CuCrZr interface). Moreover, PFC and CFC must be adapted to the in service needs. The objective of the paper is to report on PFC made with different techniques and with different CFC grades (N31, NB31, NB41, DMS814, DMS780, Dunlop 3D and SGL sgrafitto) about their inspection after manufacturing and about their thermal behavior under thermal loads.

Experimental description

- Two E.U. industries: Ansaldo Ricerche (ANSALDO), PLANSEE (PLANSEE)
- CFC grades: N31 (3D, x+y), NB31, NB41 (3D, x-y)
- Dunlop 3D, DMS814 (2D, x+y), DMS780 (2D, x-y)
- Cu/CuCrZr joining: ANSALDO: Hot Radial Pressing (HRP®) PLANSEE: Hot Isostatic Pressing (HIP®)
- Cu/CuCrZr joining: ANSALDO: Pre brazed casting (PBC)® PLANSEE: Active Metal Casting (AMC)®

Evaluation of component quality after manufacturing with SATIR, CEA

- Overall good quality of all components
- Consistent with SATIR results
- Tmax: 3D_HRP > NB41_HRP > NB41_HIP
- 3 monoblocks emerge (DTref_max=8°C, 13°C, 10°C)
- Tmax: NB31_HRP#2> NB31_HRP#1

Time response results

For all components:
- Overall good quality
- N31/DMS814 > NB31/NB41/Dunlop 3D/DMS814
- SGL For HRP components: Dunlop 3D > NB41

Better thermal exhaust capability for components with CFCs with fibers equivalent in x and y directions (ex: N11) than components with CFCs with fibers different in x and y directions (ex: NB41)

Evaluation of component quality under thermal fatigue tests (SATIR ↔ thermal screenings)

Conclusion

- 31 components with different CFC grades were studied after their manufacturing with SATIR infrared thermography. The results are:
  - Overall good quality after manufacturing.
  - Better thermal exhaust capability for components with CFCs with fibers equivalent in x and y directions than for components with CFCs with fibers different in x and y directions.
  - Presence of 3 important thermal imperfections which were noticed during initial thermal mapping.
  - One component out of CFC grade specification, which was not clearly observed with initial screening and clearly observed with final screening.
  - During HHF tests up to 1000 e at 20MWm², no water leak occurred. Erosion is visually noticed and depends on CFC grade.