Introduction

- Future magnetic confinement nuclear fusion devices, as e.g. ITER demonstration power plant (DEMO):
  - Tokamak with poloidal diverter for exhaust of power and particles
- Very challenging nuclear environment for highly loaded plasma facing components (PFCs) like the divertor targets:
  - Design surface heat flux loads: ≥ 10 MW/m² [1]
  - Neutron damage levels: ≤ 6·7 dpa/My [2]
- Combination of W & Cu in a PFC:
  - Differing thermomechanical properties, esp. CTE
  - No overlapping of operating temperature windows

Prime requirements for PFC HSMs for future magnetic confinement nuclear fusion devices:
- High thermal conductivity (> 200 W/Mk)
- High strength at elevated temperatures (≥ 400°C)
- Capability of being produced on industrial scale

- W-Cu metal matrix composites (MMCs) as advanced HSMs for highly loaded PFCs:
  - Material system W-Cu [3]:
    - Constituent materials are readily available
    - No mutual solubility / interfacial reactions
    - Very good wettability of W with Cu melt
  - Tailoring of macroscopic material properties possible
  - High thermal conductivity due to coherent Cu matrix
  - High strength at elevated temperatures due to the presence of W inclusions / reinforcements

Conclusions

- Future magnetic confinement nuclear fusion devices
- Very challenging environment for materials used for the design of highly loaded PFCs
- Melt infiltrated W-Cu composites are potential HSMs for future PFC applications
- W-Cu composite metals
- W fibre-reinforced Cu
- Future work:
  - Manufacturing process optimisation
    - Textile technological processing of W fibres
    - Melt infiltration process in industrial environment
  - Continuation of thermophysical and mechanical material characterisation
  - High heat flux testing of mock-ups with W-Cu composite heat sink


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This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement number 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.