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P3.209 Characterization and thermomechanical assessment of a SiC-sandwich material for Flow Channel Inserts in DCLL blankets

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Flow Channel Inserts (FCIs) are key elements in the Dual Coolant Lead Lihitum (DCLL) blanket since they decouple electrically the flowing PbLi and the blanket steel structure, minimizing the MHD pressure drop. Furthermore, in the high-temperature version of the DCLL (where the PbLi may reach temperatures up to 700 ℃), FCIs also protect the steel structure from the hot liquid metal.
The material for FCIs should present adequately low thermal and electrical conductivities, together with good stability against hot PbLi and enough mechanical integrity to withstand mechanical stresses derived from high thermal gradients during operation. SiC-based materials are candidates for high-temperature FCIs due to their high stability at high temperatures; specifically, a dense-porous SiC sandwich material with sufficiently low conductivities but offering reliable protection against PbLi corrosion and infiltration is an attractive option.
In the present work, a dense-porous SiC sandwich material is fabricated and characterized. The porous SiC core is manufactured from SiC powder by two different techniques, uniaxial pressing and gel-casting (the latter being industrially up-scalable); the porosity is introduced using graphite spherical powder as sacrificial template. After production of the porous SiC core, a dense SiC coating of ⊠200 ⊠m thickness is deposited by CVD. The properties of the produced material in terms of thermal and electrical conductivities (the last one including the effect of ionizing irradiation), flexural strength and stability against both static and flowing PbLi (addressing the possible influence of a magnetic field in the corrosion phenomena) are presented. In order to assess the suitability of the material for FCIs in a high-temperature DCLL, stress analysis and heat transfer simulations were also performed, taking into account the situation in the blanket (including possible MHD effects) and the properties of the material produced. The main results of these simulations are presented.

Co-author: SOTO, Carlota (CEIT)

Presenter: Dr SAL BROCO, Elisa

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