Contribution ID: **1159** | Type: **not specified**

P3.112 High heat-flux response of high-conductivity graphitic foam monoblocks

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

Plasma-facing components based on so-called monoblocks are planned for use in the divertor region of long-pulse plasma devices such as ITER and JT-60SA due to their capacity to handle high heat fluxes with active water cooling. The plasma-facing materials that are preferred for these monoblocks are tungsten for ITER or carbon-carbon fiber composite (CFC) for JT-60SA. The requirements for the plasma-facing components include the ability to handle high plasma fluxes resulting in high temperatures. Therefore, reasonably high thermal conductivity is required. In this study, graphite foam is explored as a monoblock material. Graphite foam is commercially available, is virtually isotropic (as opposed to the orthotropic CFC), and has a room temperature thermal conductivity as high as 285 W/m-K. Plasma compatibility has previously been demonstrated with small samples in the PSI-2 linear plasma device in Juelich, Germany, and the Wendelstein 7-X (W7-X) stellarator in Greifswald, Germany. The graphite foam monoblocks used for this study are manufactured and joined to CuCrZr tubes, both by brazing and by a simple press fit. The test articles consist of nine graphitic foam monoblocks 28mm x 28mm x 28mm joined either to a single 12-mm-OD CuCrZr tube or to two parallel 10-mm-OD CuCrZr tubes. These monoblocks are then tested in the GLADIS high heat-flux facility in Garching, Germany, with heat fluxes up to 10-15 MW/m2 and thermally cycled in order to examine robustness for long-pulse divertor applications. Experimental results are compared with computational fluid dynamics simulation. This new technology is under consideration for the proposed actively cooled W7-X divertor scraper element.

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Session Classification: P3