Carbon fibre reinforced carbon (CFC) is envisaged for the strike point area of the ITER divertor due to its superior resistance to excessive heat loads during off-normal events. Besides the high cost of CFCs, a main drawback of carbon-based materials is their chemical erosion under hydrogen bombardment. Doping of carbon with small amounts of certain elements such as Ti is known to reduce chemical erosion. TiC also shows a catalytic effect on the graphitisation, allowing the development of Ti-doped carbon-based materials with high thermal conductivity and high thermal shock resistance. For an effective improvement of all properties very fine and homogeneous carbide dispersion is required.

In this work finely dispersed Ti-doped isotropic graphite were manufactured and characterized with regard to thermophysical and mechanical properties, chemical erosion by deuterium bombardment, thermal shock resistance and ability of joining to a copper heat sink by brazing. The aim is to develop a doped carbon-based material which can be competitive with present CFC candidate materials for next step fusion devices.

As starting carbon raw material, a synthetic mesophase pitch with high graphitizability was used. As dopant, TiC powder with 130 nm average particle size was added. The manufacturing parameters were optimised to obtain a homogeneous TiC distribution together with the highest possible thermal conductivity and mechanical strength. Chemical erosion measurements with 30 and 200 eV D ions were performed at 600-800 K. The absolute erosion yield showed the required reduction for application of carbon as plasma-facing material, and a smooth and homogeneous TiC-enriched surface was obtained. ITER relevant thermal shock loads were applied with an energetic electron beam at the JUDITH facility. The results demonstrate a significantly improved performance of Ti-doped graphite compared to pure graphite. Finally, Ti-doped graphite samples were joined to copper by brazing. A faultless joint was obtained with a uniform reaction layer.

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