DEVELOPMENT OF PULSE PLASMA SINTERING PARAMETERS FOR TIC-CU COMPOSITES AND GRAPHITE SURFACE MODIFICATION

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The joints between CFC (carbon fiber reinforced carbon) composite as armor material and Cu alloys as heat sinks have been foreseen in ITER divertor design. The main problem in joining CFC composites with Cu is a large thermal expansion mismatch of these materials and very high contact angle of molten copper on CFC composites. In order to mitigate the high thermal stresses at the joint interface and to improve their wettability of copper, it is necessary to introduce a compensation layer. The graded Ti-Cu composite inter-layers, which are characterized by a CTE gradient is a solution investigated in this study.

Most frequently researched, considered for CFC-Cu joints fabrication so far include: (1) the use of brazing alloy with good wetting characteristics [1, 2]; (2) surface modification of the CFC by metals from VIB group and (3) application of a soft copper layer [2-5]. In Active Metal Casting (AMC) pure copper is casted on laser-machined surface activated earlier by Ti [3, 6].

The aim of this work was to obtain: a) the Ti-Cu composites of varied Ti/Cu ratio and b) a thin, solid titanium carbide layer on the graphite surface. It was shown that sintering of the Ti-Cu powder mixtures at temperature of 900°C for 300s results in fully sintered samples. A 20µm TiC layer were successfully fabricated at graphite substrate at temperature of 1100°C for 1800s.

The sintering experiments were conducted to verify feasibility of using one-stage sintering process to fabricate graded composite layers on copper substrate. The results indicate that pulse plasma sintering (PPS) technique may be an effective method for bonding the graphite to copper.

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