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TOPIC: F - Plasma Facing Components

BEHAVIOUR OF MOLTEN BERYLLIUM WITH ITER REFERENCE CFC NB31 (SNECMA) UNDER MOISTURE (P2-F-111)

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A dramatic exothermic reaction with aluminium, a carbide forming metal, has been observed in Tore Supra. A small rod of 30 mm3, acting as a temperature proof, was enclosed in a blind hole of a thermally loaded low density PAN fiber CFC 1001Z block (SGL), which reached a temperature of about 1300 °C during plasma operation. The molten aluminium had penetrated the carbon matrix through to the block's front surface. After component removal and roughly 2 months of exposure to air in the laboratory, the CFC in front of the blind hole was found to have been locally destroyed over a crater-shaped structure of 2 cm diameter. This was due to an enhanced decomposition of aluminium carbide to aluminium hydroxide.

Beryllium (Be), also a carbide forming metal, is used on the ITER first wall. Carbon reinforced carbon (CFC) of type NB31 (Snecma) covers the vertical divertor targets. It is expected that beryllium material will be transported during normal and/or off normal plasma operation to the carbon based divertor targets to form beryllium carbide. During air venting or a supposed accidental in-vessel water leak event, it will react exothermically under moisture to beryllium oxide.

In order to investigate to which extent the CFC structure could be modified or eventually destroyed, this reaction process has been simulated with a CFC block NB31 of size 16x32x20 mm3, where about 40 mm3 of Be S65 C (Brush Wellmann) has been placed in a previously drilled blind hole of 4 mm diameter oriented parallel to the high conductivity pitch fibers. When melted, by heating the CFC block, the Be penetrated in the carbon matrix through to the block's front surface. The front surface of the CFC was then exposed to humidity (tap water) for about 2 weeks and then stored for a further 2 months in a closed vinyl bag under atmospheric pressure after which the sample was analysed. After the exposure of the CFC to humidity, reaction products have been detected at the surface of the carbon fibre composite material in front of the blind hole. While SEM analyses using a secondary electron and back scattering electron detector and EDX on this contaminated area revealed the presence of a carbon layer and BeO, no substantial macroscopic CFC surface destructions were visible.

The experimental description of both experiments will be given and detailed analyses reported.