Progress in HHF testing of RF beryllium for ITER Fist Wall application

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Beryllium will be used as a plasma facing material in the ITER First Wall and Port Limiter. During ITER operating the beryllium armour of first wall will be exposed by (1) steady heat loads (normal event) that will provoke both permanent and cyclic fatigue stresses of moderate level and (2) plasma instabilities of different kind ("off-normal" event), which will stimulate high local stresses (disruptions, VDE, ELMs). All these events may lead to surface melting, cracking, evaporation and erosion of beryllium.
For Be armour, thermal fatigue/shock resistance is the most important factor, because cracking may lead not only to the intensified armour erosion but to damage of its joint with the heat sink structure.

This paper presents recent results of a complex HHF testing of two modification of TGP-56FW beryllium grade in comparison with S-65C grade. The complex thermal loading of beryllium was performed using two actively cooled Be/CuCrZr brazing mock-ups, each of them was armored with four beryllium tiles of 40 × 24 × 10 mm^3. Each tile of every mock-up was loaded in the electron beam facility JUDITH 1 in the following way: 1) VDE simulation test at 40 MJ/m^2, 1 shot, 0.3 s; 2) Disruption simulation at 3 MJ/m^2, 2 shots, Δt = 5 ms; 3) Low cycle fatigue test at 80 MW/ m^2, 1000 shots, Δt = 25 ms. In addition to 1) - 4) tests, the second mock-up was exposed to 1000 cycles at 2 MW/m^2, Δt = 15 s heating /15 s cooling. The results of metallographic studies of microstructure and cracks morphology in Be tiles after this complex thermal loading will be reported and discussed.

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