DEVELOPMENT OF THE ARMORING TECHNIQUE FOR ITER DIVERTOR DOME

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D.V. Efremov Institute works on ITER project since 1988, when the project was established. Development of plasma facing high heat flux (HHF) components is one of several fields of Institute activity related to this project. Efremov Institute has now a procurement contract for ITER divertor Dome.
This paper describes current status of the technique planned for application in the procurement stage for armoring of Plasma Facing Units (PFUs) of ITER Divertor Dome with flat tungsten tiles. Descriptions of the armor production technology, of the armor joining procedure and principal features of applied techniques are given in principal details.

ITER Divertor Dome is designed with the armor consisting of flat tungsten tiles, joined to the CuCrZr/SS substrate elements via 2 mm thick ductile layer of OFHC copper. Almost flat configuration of the interfaces between armoring tiles, Cu interlayer and CuCrZr surface of the heat sink is suitable for making of these joints by brazing. The technique of application of high-temperature vacuum brazing for armoring of HHF plasma facing components was traditionally developed and well proved at Efremov Institute by manufacturing and HHF testing a lot of W-armored divertor mock-ups in the ITER R&D stage [1, 2, 3].

Nevertheless, during manufacturing of the Dome Qualification Prototypes (Dome QPs) the technique of armor brazing has been considerably revised. This revision was provoked mainly by the well-known scale factor, incarnated in much lager mass and thermal capacity of the Plasma Facing Units (PFUs) of the QPs in comparison with small-sized R&D mock-ups. There was no possibility heat-up a real-size PFU to perform the armor brazing and then cool it down so fast as it allows saving mechanical properties of CuCrZr heat sink part of the substrate. So-called “fast brazing”, widely and successfully applied in the past, did not work more. So, issue of adaptation of the brazing technique to the “full-scale reality” has arisen. Finally this problem was fixed by application for brazing of newly developed and optimized thermal cycle, integrated in one the armor brazing and the CuCrZr strength recovery.
The second challenge was concerned of substantial increase of number of the armoring tiles brazed onto one PFU substrate. Larger quantity of tiles led to higher probability of brazing defects occurrence. Together with severe ITER requirements to quality of the brazing joints it brought to the cancellation of making of the W/Cu joints by brazing and turned us to production of this joint only by casting.

These deep changes and other modifications of the armor brazing technique finally allowed production of the ITER divertor Dome QPs having high-quality tungsten armor. These Prototypes successfully passed HHF testing and work on further preparation to the procurement stage now is in progress.