AN INNOVATIVE MINICHANNEL COOLING SYSTEM FOR GYROTRON CAVITIES

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ABSTRACT

Several improvements have been made on gyrotron solutions in order to maximize power and efficiency levels. The Thales TH1507U 1.5 MW for W7-X [1-2] and the TH1509U 170 GHz ITER gyrotron [3-4] represent the state of the art of these technologies. Increasing performances are constantly demanded, especially for future DEMO gyrotrons [5] where the heat load on the cavity wall is one of the major limiting factors [6-7]. In this frame, an improved mini-channel cavity cooling circuit has been developed and a mock-up has been manufactured. Compared to existing solutions [6-8], the proposed system increases the heat exchange while limiting thermo-mechanical stress and anisotropic deformations. The structure consists of two coaxial elements, where the fluid flow is placed as close as possible to the heated wall to increase heat exchange, and an adaptive profile of the outer element dilates and displaces during the operation to limit stress. The proposed solution can be realized by traditional mechanical processes and proven brazing techniques. Compared to Raschig rings cooling solution, for the same peak heat load of 1.85 kW/cm^2 and water flow of 65 l/min, a preliminary single-step simulation by PoliTO, based on the TH1507U cavity, shows a max temperature reduced from 222°C to 165°C with a stress level around 250 MPa, giving margin of 50 MPa before plasticization. Full loop multiphysics simulations are being performed with NKUA and a mock-up has been manufactured in order to be tested at KIT for technological validation.

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