DEVELOPMENT AND APPLICATIONS OF THE DUAL-BEAM ION IRRADIATION FACILITY FOR FUSION MATERIALS (DIFU) AT RBI, ZAGREB

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We present the Dual-beam ion irradiation facility for FUsion materials (DiFU) developed at Ruđer Bošković Institute in Zagreb, Croatia. It has a versatile setup which allows irradiation of fusion materials samples by one or two ion beams as well as other similar experiments. Two beamlines come to the DiFU chamber at an angle of 17^0 between them, from 6 MV HVE Tandem VDG and 1 MV HVE Tandetron accelerator. Ion beam handling and scanning systems enable fast electrostatic scanning of the beams over the sample at kHz frequencies, and irradiation of areas up to 30x30 mm^2. The sample holder enables XYZ positioning of heated, cooled or room temperature samples. Ion fluxes are measured indirectly by insertion of two large Faraday cups in ion beams and the ion flux is also monitored continuously by two sets of XY slits. Conditions during irradiation are monitored by a set of thermocouples, an IR camera, a high-sensitive video-camera, and a residual gas analyser. The DiFU facility has been developed according to ASTM standard E521-16 [1] with support from EUROfusion, the IAEA and the Croatian Science Foundation.

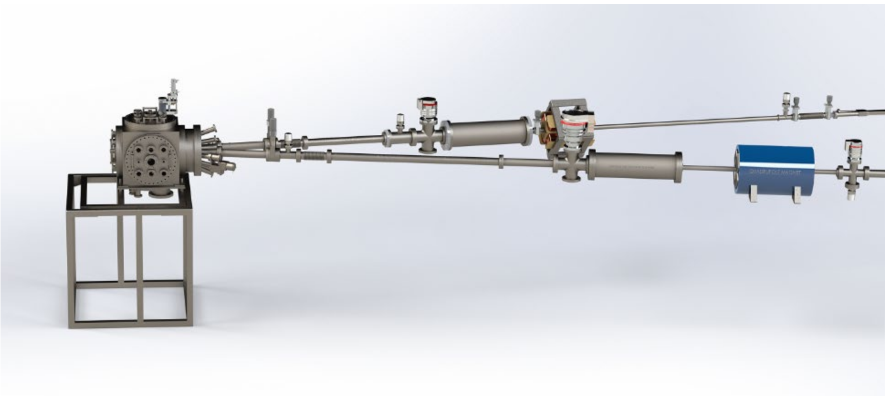

FIG. 1. Drawing of the DiFU chamber along with both beamlines

Ion beam irradiation can be used to emulate neutron irradiation effects in reactors [2]. Dual-beam facilities such as this are especially important for applications in fusion materials due to their ability to simultaneously reproduce the effects of radiation damage and helium or hydrogen formation inside a fusion power plant. The Tandetron accelerator can be used for light ion implantation, while the VDG damages the material with heavy ions. Particular care has been dedicated to mitigating carbon contamination during irradiation [3], an issue which has been shown to significantly affect the results of post-irradiation characterizations of materials [4]. Research into this effect is still ongoing.

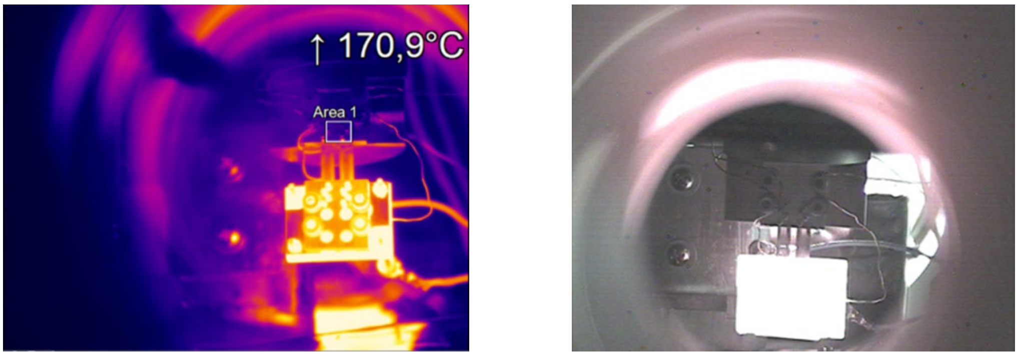

FIG. 2. IR and ordinary camera captures of a high-temperature irradiation

Material irradiation experiments conducted include a novel method of creating a temperature gradient in the material [5], as well as continuous irradiations of more than 24h to achieve a high doses in the range of 10 dpa [6]. The setup is also used in other irradiation or implantation experiments where the precise determination of fluence and a broad beam are needed.

REFERENCES

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