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P3.20 2Development of a novel irradiation chamber to assess the influence of magnetic fields on radiation damage in materials

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To date the research on structural materials for future fusion reactors has been focused on the evolution of mechanical properties with irradiation dose, energy, temperature, etc. However, the performance of materials irradiated under the presence of magnetic fields remains unclear. This aspect becomes critical, as structural materials in fusion reactors will need to withstand intense and hazardous radiation environments under the presence of strong magnetic fields. In principle, material micro-structural and mechanical properties are modified by radiation-induce propagating defects. It is hypothesized that such propagation is sensitive to magnetic fields. Therefore, experiments are essential to investigate mobility, recombination, clustering or dissociation of defects, hydrogen and helium creation in structural materials. Indeed, recent irradiation experiments point to external magnetic fields as a key parameter in Cr mobility. Experiments to clarify this have been already carried out under external field strengths of around 0.4 T and temperatures up to 100 ºC, however this values are well below those expected in future reactors.
In order to reproduce fusion relevant conditions, a sample irradiation chamber consisting of a magnetic flux concentrator (around 1 T) and a sample holder with an oven mounted on a manipulator, have been developed for the Danfysik implanter at Ciemat. In order to minimize magnetic flux losses a magnet is close coupled to both, the sample and oven in this compact system. A magnet temperature below 150 ºC, when the sample is at 450 ºC, is guaranteed by means of a thermal shield (thermocouples monitor both temperatures). The magnetic flux concentrator and manipulator have been fabricated and initial tests are underway. The design, along with first results from irradiation studies of structural material alloys (FeCr) will be presented. For this, samples will be helium implanted with/without magnetic field at high temperature. Implanted samples will be studied using several techniques.

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