# Radiation Damage Studies for Fe-Based Alloys Under 30 MeV Proton Irradiation

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Materials should be radiation resistant for safe and reliable operation in radiation environments. Therefore, radiation tests are crucial for new candidate materials. Proton tests are critical for materials intended for use in nuclear reactors that produce hydrogen and hydrogen isotope ions and in the space environment that consists mostly of protons. Generally, crystalline materials are used in nuclear reactors and in space for their mechanical robustness. However, amorphous alloys have received much attention due to their physical, chemical, mechanical and magnetic properties compared to their crystalline counterparts. Therefore, owing to high strength and hardness and good wear and corrosion resistance, new generations of Fe-based bulk metallic glasses (BMGs) have great potential for these applications as much as conventional steels. Although, extensive studies have been performed on crystalline metallic materials, unfortunately, little attempts have been made so far on the response of the BMG under these severe service conditions.

In this study, therefore, attempts have been made to investigate effects of radiation on both amorphous and crystalline Fe-based materials. Fe-based BMG was produced by arc melting and then suction casting into copper mold in the form of cylindrical rod with diameter of 3 mm and length of 50-100 mm in argon atmosphere. In addition to Fe-based BMG commercially available 304 and 316 SS were tested at METU-DBL which is a proton irradiation facility in Turkey [1]. An irradiation campaign with 30 MeV protons was performed in March 2018. Samples were irradiated up to 3 different fluences between 5.5×109 - 4.0×1010 p/cm2 for comparison. Structural, thermal, mechanical and magnetic characterization techniques were employed to examine the effects of radiation on materials compared to samples that were not irradiated. In this present study, the response of both amorphous and crystalline samples upon irradiation will be presented in terms of their structures and associated mechanical and magnetic properties.

[1] Demirköz, B., et al. "METU Defocusing Beamline Project for the First SEE Tests in Turkey and the Test Results from the METU-DBL Preliminary Setup." NUCL INSTRUM METH A (2018).