Normal and superconducting properties of Co–doped BaFe$_2$As$_2$ and MgB$_2$ thin films after He ion irradiation

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We have investigated the normal and superconducting properties of Co-doped BaFe$_2$As$_2$ (Ba122) and MgB$_2$ bridges irradiated at room temperature using a 30 kV He$^+$ beam (ZEISS Orion Plus Helium ion microscope) and doses between $10^{13}$ to $10^{17}$/cm$^2$. Our results show that the critical temperature of irradiated region reduces to $<2$K for doses $>3 \times 10^{14}$/cm$^2$ for Ba122 and $\sim 1 \times 10^{16}$/cm$^2$ for MgB$_2$ films. All the samples show a consistent increase in the resistivity of irradiated region with the increase in the beam dose. Furthermore, irradiated Ba122 becomes insulating at high enough dose ($6 \times 10^{16}$/cm$^2$) while MgB$_2$ remains metallic at all doses used. This result for Ba122 allows us to fabricate planar SIS Josephson junction in this material; RSJ-like behavior and typical critical voltages $I_c R_n$ of 400 V are seen at 10 K.

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