Effect of ion irradiation on the crystallization of Ge via AlILE process

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To achieve crystallization of amorphous semiconductors at low temperatures, metal contact is made with which the semiconductor forms a eutectic phase known as metal induced crystallization (MIC). In recent, ion beam irradiation have been used as a tool to reduce the crystallization temeperature of Si and Ge [1-5]. The ion beam irradiation, athermal process, has several advantages over thermal annealing such as spatial selectivity of samples, high precision, and lower processing time. In the present paper, the polycrystalline (*p*-) Al (50 nm)/ amorphous (*a*-) Ge (50 nm) is irradiated using 1000 keV Xe^+ ions with fluences of 7×10^{14} ions/cm^2, 3×10^{15} ions/cm^2 and 1×10^{16} ions/cm^2 followed by post thermal annealing at 200 °C. The pristine (i.e., as-prepared) sample is also thermally annealed for comparison purposes. The X-ray diffraction measurement confirms the crystallization of Ge after thermal annealing in both pristine and ion irradiated samples whereas only ion irradiation does not show any crystallization of Ge. The optical micrograph and field emission scanning electron microscopy (FE-SEM) images show dotted like structures on the surface of the film which are found to increase with increasing ion fluence. The Rutherford backscattering spectrometry confirms the interface mixing and the energy dispersive X-ray spectroscopy confirms the layer exchange phenomena at the interface in the *c*-Al/*a*-Ge bilayer system. The produced polycrystalline Ge may be used as IR sensors or thermoelectric power generation application in future.

References

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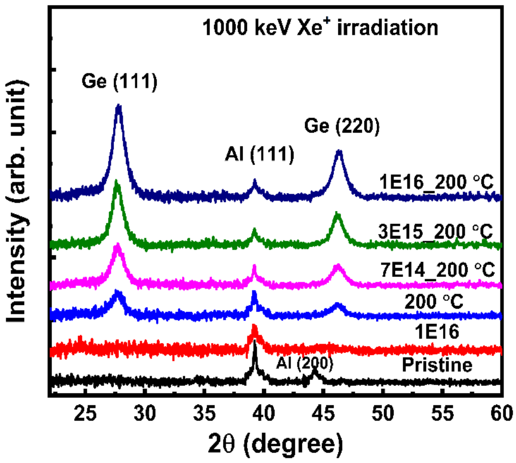

Figure 1: XRD data of *p*-Al/*a*-Ge irradiated with 1000 keV Xe^+ at a fluence of 1×10^{16} ions-cm^{-2}, annealed at 200 °C, and irradiation with different fluence 7×10^{14}, 3×10^{15}, 1×10^{16} ions-cm^{-2} followed by annealing at a fixed temperature of 200 °C

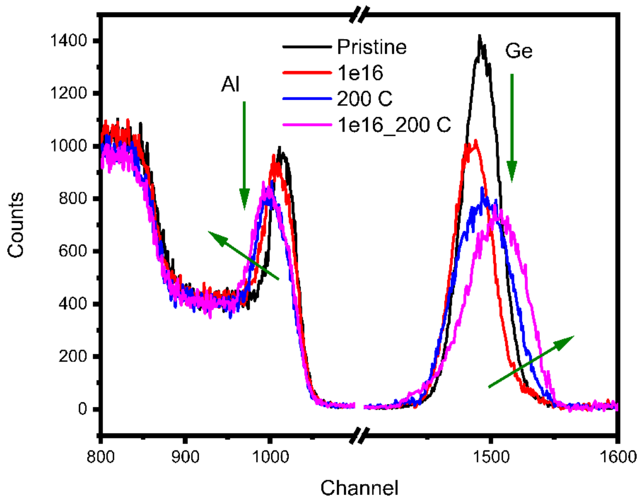

Figure 2: RBS spectra of *p*-Al/*a*-Ge (pristine), irradiated with 1000 keV Xe^+ ion at a fluence of 1×10^{16} ions-cm^{-2}, annealed at 200 °C and irradiated at a fluence of 1×10^{16} ions-cm^{-2}followed by annealing at 200 °C

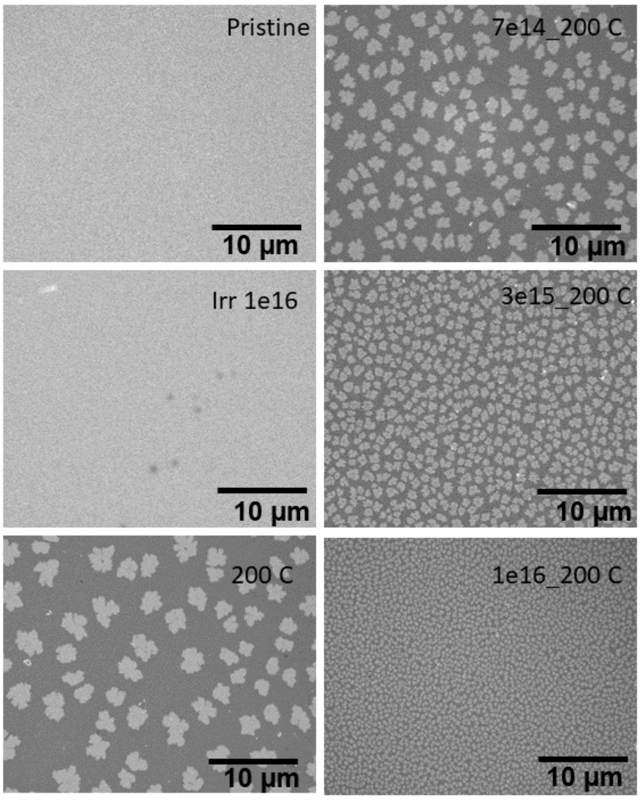

Figure 3: FESEM image of *p*-Al/*a*-Ge irradiated with 1000 keV Xe^+ at a fluence of 1×10^{16} ions-cm^{-2}, annealed at 200 °C, and irradiation with different fluence 7×10^{14}, 3×10^{15}, 1×10^{16} ions-cm^{-2} followed by annealing at a fixed temperature of 200 °C

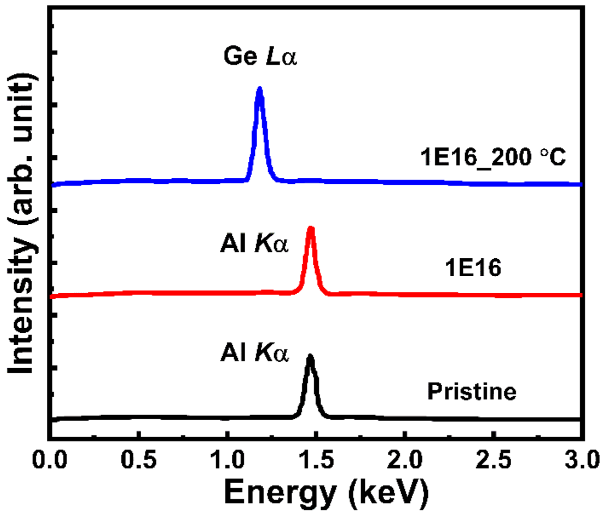

Figure 4: EDX spectra of *p*-Al/*a*-Ge (pristine), irradiated with 1000 keV Xe+ ion at a fluence of 1×10^{16} ions-cm^{-2} and irradiated at a fluence of 1×10^{16} ions-cm^{-2}followed by annealing at 200 °C