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Kinetically stabilized abrupt interface between Fe film and GaAs(100)

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Fe/GaAs(001) system has great potential as a spintronic device, where efficient spin injection from Fe film into GaAs(100) is required.

However, disruptive Fe growth on the GaAs surface results in unwanted defects such as segregated As and alloy formation at the interface. Both defects severely lower the magnetization of Fe film near the interface and critically hamper spin injection efficiency.

To increase spin injection efficiency, it is very important to grow Fe on GaAs(100) without such defects. As a solution, we attempt to limit the diffusion of atoms at the interface and prohibit segregation and formation of alloy of Ga and As by growing Fe film at low substrate temperature, < 150 K.

Through careful analysis of photoelectron (PE) spectra, we separate 3 different As contributions (substrate GaAs, Fe-As alloy, and segregated As atoms) from As 3d peak. For room temperature grown sample, we find the As 3d intensity from segregated As that is about 30% of that from substrate even though the Fe films is more than 40A thick. On the other hand, for low temperature grown sample, we observe that As-segregation is suppressed remarkably and the alloy formation is substantially reduced: segregated As definitely disappears from the PE spectra. When the Fe thickness is thicker than 15 A, we cannot separate As 3d peak from background.