Microscopic Mechanism of the Exchange Bias in $Mn_{50}Ni_{40-x}Sn_{10+x}$: a Small-Angle Neutron Scattering Study

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Polycrystalline Ni–Mn–Sn Heusler alloys show a large exchange bias field below a blocking temperature T_B [1-3], making them promising candidates for future spin valve and magnetic recording devices. Here, we use small-angle neutron scattering (SANS) [4] to directly image the magnetization process in $Mn_{50}Ni_{40-x}Sn_{10+x}$ in the reciporcal space. At zero field and low temperatures, we are able to observe the coexistence of ferromagnetic domains (> 100 nm) and local clusters (~ 10 nm). In the field-induced magnetization process below T_B, the ferromagnetic domains and domain / cluster interfaces exhibit a large susceptibility at the exchange bias field, as revealed by the Porod fitting to the scattering data, while the local clusters remain relatively resilient. These results agree with the theory where exchange bias results from the ferromagnetic unidirentional anisotropy formed at the interfaces between different magnetic phases [5].

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