The influence of Si insertion on appearance of antiferromagnetic coupling in Fe/Ge multilayers

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In order to compare Fe/Ge multilayers (Mls) with Fe/Si system reported previously [1-3] Fe/Ge, Fe/Si/Ge/Si and Fe/Ge/Si/Ge Mls were prepared. The samples were deposited by magnetron sputtering onto oxidized Si substrates at room temperature. Magnetization and interface structure of the samples were studied at room temperature by vibrating sample magnetometer (VSM) and conversion electron Mössbauer spectroscopy (CEMS), respectively. Magnetization measurements of the Fe(3 nm)/Ge(d_{Ge}) series revealed no antiferromagnetic (AF) coupling for $0.5 < d_{Ge} < 3$ nm, in contrast to Fe/Si system where the maximum of AF coupling was observed in the range of d_{Si} = 1.1 - 1.35 nm [1] (Fig. 1). In order to find out the influence of Si on AF coupling, Ge was partially substituted by Si in the spacer layer, *i.e.*, the Fe/Si/Ge/Si and Fe/Ge/Si/Ge Mls were prepared with constant spacer thickness d_{Si+Ge} = 1.1 nm. We found that addition of at least 0.5 nm of Si in the spacer, introduced either at the Fe/Ge interface or in the center of Ge spacer, lead to appearance of AF coupling with strength increasing with Si sublayer thickness (Fig. 2). In Fe(d_{Fe})/Ge(2 nm) Mls it was found that 0.5 nm of Fe dissolved at each interface during deposition into the spacer and became nonmagnetic, this value is twice as much as found in Fe/Si Mls (*i.e.* 0.25 nm [2]).

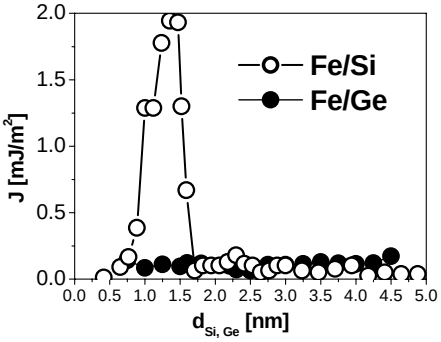

Fig. 1. AF coupling energy versus Si and Ge spacer thickness

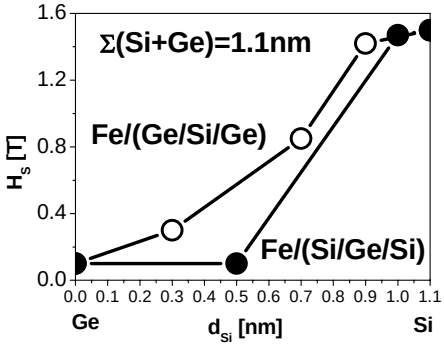

Fig. 2. Influence of Si sublayer thickness on the appearance of AF coupling

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