Magnetic and structural properties of epitaxial $Fe/Fe_3O_4/Fe$ tri-layers.

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A series of $Fe_I/Fe_3O_4/Fe_{II}$ trilayers with varying thickness of the magnetite spacer layer were epitaxially grown on cleaved MgO(001) single crystals. The thickness of the $^{56}Fe_I$ and $^{56}Fe_{II}$ layers was fixed to 20nm and 10nm, respectively, whereas the spacer thickness was varied between 1-20 nm. Structural properties and chemical composition of the samples were monitored at each preparation step by LEED and AES. CEMS was used to follow magnetic and structural properties of the $^{57}Fe_3O_4$ spacer grown using ^{57}Fe isotope. Magnetic hysteresis loops were measured *in-situ* by the longitudinal MOKE at each preparation step with external magnetic field applied along different in-plane crystallographic directions. Ex-situ temperature dependent MOKE measurements were performed in the LN_2 flow cryostat. The MOKE loops indicate anti-parallel alignment of magnetic moments in the Fe_I and Fe_{II} layers for the all investigated tri-layers. The CEMS data showed that except of dominating magnetite phase there is a thin layer (most probably FeO-like) formed at the Fe_I/Fe_3O_4 and Fe_3O_4/Fe_{II} interfaces. Additionally, a significant exchange of Fe atoms between the iron layers and the magnetite spacer can be concluded from the analysis of the CEMS spectra.