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POS-23 - Spin current transport in Ta: FMR studies in py/Ta and py/Ta/py/Fe structures prepared by sputtering

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Spin current transport generated by spin pumping was investigated in magnetic single py (Ni80Fe20)/Ta and double py/Ta/py/Fe layer structures prepared by magnetron sputtering. Ferromagnetic Resonance (FMR) generates rf pure spin current at the py/Ta interface. This leads to an interface Gilbert damping α_{sp} characterized by the spin mixing conductance parameter $g_{\uparrow\downarrow}$. Spin current propagation in Ta overlayer is governed by spin diffusion of the accumulated spin density in Ta. Ta belongs to heavy metals where the spin diffusion length λ_{sd} is very short, ˜1 nm, compared to that of other simple metals Pd, Au and Cu. It is comparable to that found in Pt, where a short spin diffusion length by FMR studies was interpreted by interface spin loss due to Rashba interface scattering. X-ray diffraction (XRD) and transmission electron microscope (TEM) studies showed that the sputtered Ta films are amorphous in the thickness region where the spin transport is significant. The parameters describing the spin transport in Ta are the resistivity of Ta layer and spin diffusion length. We found that consistent and unique set of parameters describing spin pumping requires to carry out FMR studies on both the single magnetic structure py/Ta and double magnetic layer py/Ta/py/Fe where py/Fe layer acts as perfect spin sink. For the single magnetic layer the spin pumping Gilbert damping, α_{sp}, increases with an increasing Ta thickness d_{Ta} while in magnetic double layer it starts with maximum α_{sp} and then decreases approaching the same asymptotic value when d_{Ta}»λ_{sd}. We used several models and found that a consistent fit can be reached by using ρ=370 $\mu\Omega$ cm, λ_{sd}=1 nm, and $g_{\uparrow\downarrow}$=1.7×10^{15} cm^{-2}. The resistivity parameter was in agreement with ex situ four probe resistivity measurements. Our studies show that there is no interface spin loss in py/Ta compared to that found in py/Pt.

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