Magnetic domain structure and interfacial Dzyaloshinskii-Moriya interaction in the epitaxial W/Co/Pt multilayers

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The Dzyaloshinskii-Moriya interaction (DMI) is responsible for creation of chiral magnetic spin structures like: spin spirals or skyrmions, which are potential candidates for data storage in thin film technology. In this work we investigate the domain structure and the DMI strength in the epitaxial W(1 nm)/Co(0.6 nm)/Pt(1 nm) multilayers with perpendicular magnetization. These systems exhibit a better defined crystalline structure and the interfaces, crucial for DMI, in comparison to commonly studied sputtered stacks. In the as-deposited state the labyrinth configuration of magnetic domains is observed. It can be converted to the stripe domains by application of the in-plane oriented magnetic field. The DMI strength is determined from the domain structure size in the effective medium approach [1]. It reaches as high as $D_{eff} = 2.64$ mJ/m^2 (surface DMI parameter $D_S = 1.83$ pJ/m) value for repetition number of the basic trilayer equal to 10 [2]. The experimentally observed domain structure and the DMI strength are exactly reproduced in the micromagnetic modelling and DFT calculations, respectively. Moreover, the DFT calculations revealed the interfacial nature of DMI and the additive contribution from the two W/Co and Co/Pt interfaces. The determined DMI strength suggests that the structure of the domain walls might be of the pure Néel type.

References:

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