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Perpendicular magnetic anisotropy and magnetic domain walls in cobalt films intercalated under graphene

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Since the discovery of graphene, it has continually attracted the scientific community's attention due to its promising properties. Some efforts have been spent on understanding the influence of graphene at magnetic thin films interfaces. Systems with graphene/magnetic metal interface have shown a significant enhancement of the perpendicular magnetic anisotropy (PMA)[1,2]. However, the mechanism behind such effect is not well known yet, neither the influence of external agents, as temperature, on it.

In this work, we prepared defect-rich graphene on three different substrates, Ru (0001) and Ir (111) by chemical vapor deposition using ethylene (C2H4) at 10-8 torr and with substrate temperature between 600 and 650 ℃. Then, Co was deposited step by step (monolayer by monolayer) in ultra-high vacuum, where in which step, the Co layer was intercalated by annealing to 300 ℃.

We have studied the thickness dependent spin reorientation transition (SRT) and the domain wall evolution using spin polarized low energy electron microscopy (SPLEEM) on graphene/Co/Ru(0001) and graphene/Co/Ir(111) interfaces. In both systems, we observed an enhancement of the PMA. A smooth SRT starts at 13 ML for Ru and at 14 ML for Ir, respectively, with the magnetization going from out of plane to in plane through a canted intermediate state, ranging for at least 6 ML. The enhancement of PMA induced by graphene can be understood as a consequence of a strong hybridization of graphene with cobalt in directional bonds, making the contribution of the graphene/cobalt interface to the PMA much stronger than the contribution from the cobalt/substrate interface.

In both systems, besides an enhancement of the PMA, we have demonstrated that the evolution of magnetic domain walls in the SRT process is also a key point for understanding the magnetic properties of such systems.

References:

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