Spin-Orbit Coupling in Graphene-MoS_2 Hybrid Structures: an X-Ray Absorption Spectroscopy Study

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Spintronics is one of the vast prospects for applications of 2-dimensional materials. In particular, the combination of graphene with materials with large spin-orbit coupling (SOC) is offering new opportunities of achieving control and manipulation of spin transport in hybrid structures. A large enhancement in SOC of graphene interfaced with semiconducting transition metal dichalcogenides (TMDCs) has been predicted [1]. Experiments focusing on spin relaxation anisotropy have recently confirmed that the large SOC and spin–valley coupling in a semiconducting TMDC can be imprinted in graphene [2]. However, such measurements are indirect since they do not provide quantitative information about the SOC enhancement, while the mechanisms responsible are yet to be fully understood and, as a result, are not totally controlled. One of the experimental techniques that allows for a direct detection and measurement of SOC is x-ray absorption spectroscopy (XAS). We have used XAS to probe the electronic states of Graphene/MoS2 structures in order to investigate SOC proximity effects. Analysis of the core-level spin-orbit split branching ratio [3] at the Mo XAS $L_{2,3}$ edges allowed us to quantify the change in SOC in the Mo 4*d* states in contact with graphene. Moreover, evidences of strong interlayer hybridization between the Mo 4*d* states and graphene π orbitals are observed, which is highly relevant to understand the mechanisms by which the SOC in graphene is enhanced in these heterostructures.

References

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