Proximity Magnetoresistance on graphene induced by magnetic insulators

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Graphene has been attracting great interest due to its fascinating characteristics for development of graphene-based devices in several fields [1,2]. When it is placed on top of a magnetic insulator, it can acquire spin polarization [3]. Evidence of this effect is the emergence of exchange splitting in the graphene band structure reported experimentally [4,5] and theoretically [3,6]. Here we demonstrate the existence of proximity magneto-resistance (PMR) effect in graphene considering magnetic insulator proximity cases reported in Ref. [6]. The PMR calculations were performed using KWANT package [7], for yttrium iron garnet (YIG), cobalt ferrite (CFO), and two europium chalcogenides EuO and EuS [6]. The system studied consisted of two identical proximity induced magnetic regions of width W, length d and separated a distance L_m of a graphene sheet, with its ends connected to two leads [Fig. 1(a)]. We found significant PMR (up to 100%) values defined as a relative change of graphene conductance with respect to parallel and antiparallel alignment of two proximity induced magnetic regions. Namely, for high Curie temperature (Tc) CFO and YIG insulators which are particularly important for applications, we obtained 25% and 80% at room temperature, respectively [Fig. 1(b)]. We also found that the PMR is robust with respect to magnetic region separation, in contrast with its dependency on lengths. Our findings show that it is possible to explore spin polarized currents in graphene with no direct injection through magnetic materials. We acknowledge EU H2020 Programme Graphene Flagship (agreement No. 696656).

References

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Figures

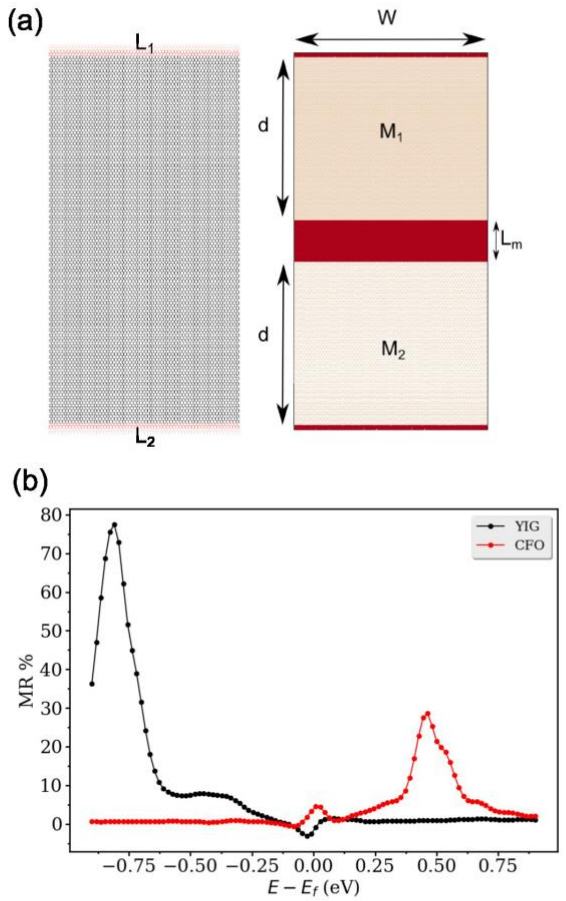

Figure 1: (a) Graphene sheet comprising two proximity induced magnetic regions M_1 and M_2 of width W and length d separated a distance L_m, connected to leads L_1 and L_2. (b) PMR value as a function of energy for YIG and CFO at room temperature in a system with W = 14.8nm, d = 12.8nm and L_m = 1.5nm.