Dilute interlayer cobalt doping induced ferromagnetism in semiconducting BP and superconducting $NbSe_2$

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We present a minimally invasive route to engineer ferromagnetism in layered, intrinsically non-magnetic 2D materials by inserting dilute cobalt between van der Waals layers, avoiding direct substitutional disorder that typically degrades the host lattice and its native electronic phases. Using such hBN-enabled interlayer doping and magnetic tunnel junctions as a common probe, we obtain clear tunnelling magnetoresistance (TMR) signatures of an induced ferromagnetic state in multiple platforms. We highlight two examples: (i) black phosphorus converted into a dilute magnetic semiconductor while retaining gate-tunable transport [1], and (ii) Co-doped $NbSe_2$ where ferromagnetism appears only below the superconducting transition, consistent with superconductivity-mediated exchange [2]. These results establish dilute interlayer cobalt doping as a general strategy to add magnetism while preserving the functional properties of 2D semiconductors and superconductors.

References

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