Engineering the Two-Dimensional Hole Gas on Diamond by Surface Transfer Doping for Future Carbon Electronics

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Despite being a bona-fide bulk insulator, diamond develops an intriguing two-dimensional (2D) p-type surface conductivity when its surface is terminated by hydrogen and exposed to appropriate surface adsorbate layer such as atmospheric water as a result of the surface transfer doping process. Consequently, the surface of diamond presents a versatile platform for exploiting some of the extraordinary physical and chemical properties of diamond, leading to applications such as chemical/biological sensing and the development of high-power and high-frequency field effect transistors (FETs) [1].

In this talk, I will describe our recent work on the surface transfer doping of diamond by transition metal oxides (TMOs) [2]. Specifically, I will show that by interfacing diamond with MoO_3 or V_2O_5 a 2D hole conducting layer with metallic transport behaviours arises on diamond [3]. The 2D hole layer affords a surprisingly large spin-orbit interaction giving rise to exotic quantum coherent spin transport properties as revealed by low-temperature magnetotransport. The spin transport can be further tuned by an external electric field in a metal-oxide-semiconductor FETs (MOSFETs) architecture [4, 5]. Lastly, solution-processible approaches for the formation of ultrathin metal-oxide layers on diamond to enable *p*-channel diamond surface electronics are also explored [6, 7].

Reference

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