# Electron pairing by remote-phonon scattering in oxide-supported graphene

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Using first principles calculations we have shown that placing graphene on a (111)-oriented perovskite $SrTiO_3$ (STO) surface provides a possible doping mechanism [1]. Further theoretical analysis presented here suggests that coupling of electrons in graphene to interfacial hybrid plasmon/optical modes via remote-phonon scattering may result in an effective attractive electron-electron interaction that, in turn, could lead to electron pairing and superconductivity [2]. Specifically, we consider top-gated graphene supported by STO as shown in Fig.1. Using the full dynamic polarizability within the random phase approximation (RPA) for the entire system (including the hybrid modes arising from the coupling of the graphene plasmons to the optical phonons of the STO substrate and gate insulator), we estimate the superconducting transition temperature in the strong-coupling limit. In Fig. 2, we show the estimated superconducting critical temperature as a function of carrier density for different oxide thicknesses. As the carrier density increases, the critical temperature increases. The critical temperature is higher in the system of thicker $HfO_2$ oxide since the electron-IPP interaction is stronger with thicker top-gate oxide.

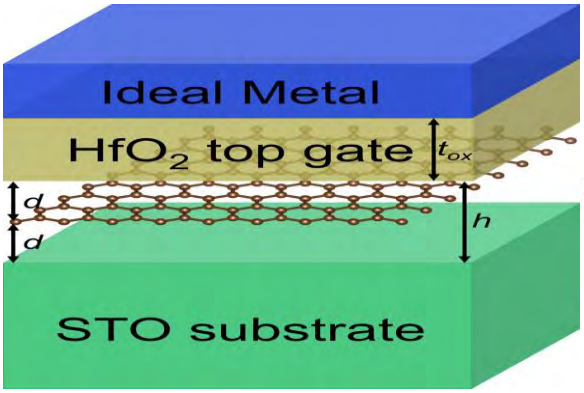


Figure 1. Schematic of a model used in our calculation. Here the STO substrate is assumed to be semi-infinite and the graphene layer is laterally infinite in the vacuum region between $HfO_2$ and STO.

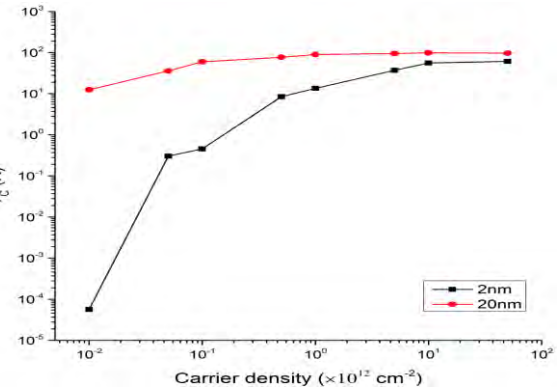


Figure 2. Estimated superconducting critical temperature as a function of carrier density and the two indicated values of the oxide thickness in the strong-coupling limit.

[1] D. Shin and A. A. Demkov, Phys. Rev. B **97**, 075423 (2018).

[2] D. Shin, M. V. Fischetti, and A. A. Demkov, Phys. Rev. B **100**, 125417 (2019).

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