Excitonic Effects in Layered Materials

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Abstract

Layered materials such as graphene and monolayer transition metal dichalcogenides (TMDs) exhibit wonderful optoelectronic properties resulting from their reduced dimensionality and crystal symmetry. In particular, TMDs are semiconductors with a direct band gap in the monolayer limit and a highly efficient light-matter coupling. Consequently, this family of layered materials is especially promising for fundamental studies and potential applications in optoelectronics, valleytronics and quantum technology. The inversion asymmetric crystal structure of TMD monolayers combined with strong spin-orbit interactions results into a unique combination of the spin and valley degrees of freedom. Importantly, the 2D confinement of the carriers and the weak dielectric screening from the environment enhances the Coulomb interaction. This results in the formation of bound electron-hole pairs (i.e. excitons) that govern the optical and spin properties of the material. In this talk, I will provide a basic understanding of the crystal and electronic structure of the TMD monolayers family. A simple description of the electron-hole pair interactions and their optical selection rules will be provided. Finally, the exciton lifetime as well as our current understanding of the formation of various excitonic complexes in these structures will be discussed

References

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