Exploring Excitonic Effects in Transition Metal Dichalcogenides Monolayers

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Transition metal dichalcogenides (TMDs) monolayers have gained significant attention in recent years due to their unique electronic properties and potential applications in various optoelectronic devices. This presentation delves into the intriguing world of excitonic effects in TMDs, shedding light on the fundamental aspects and practical implications of these phenomena. Excitons, which are bound electron-hole pairs, play a pivotal role in the optical properties of TMDs. This presentation begins by providing an overview of the crystallographic and electronic structure of TMDs, emphasizing the presence of tightly bound excitons resulting from the reduced dielectric screening in two-dimensional materials. It explores the delicate interplay between Coulombic interactions and quantum confinement, showcasing how these effects give rise to exciton-related phenomena such as exciton binding energies, radiative and non-radiative recombination processes, and exciton fine structure. Furthermore, we will discuss the experimental techniques and theoretical methods employed to investigate excitonic effects in TMDs, including photoluminescence spectroscopy, time-resolved measurements, and wannier equation calculations. These tools are essential for gaining a deeper understanding of the excitonic behavior and its impact on the material's optical properties. The presentation will also touch upon the practical implications of excitonic effects in TMDs, highlighting their role in the development of next-generation photodetectors, solar cells, and light-emitting devices. By tailoring the excitonic properties through material engineering, it is possible to enhance the performance of these devices and explore novel applications. In summary, this presentation offers an in-depth exploration of excitonic effects in transition metal dichalcogenides, shedding light on the underlying physics and their significance in emerging optoelectronic technologies. By comprehending and harnessing these phenomena, we can pave the way for innovative materials and devices with enhanced performance and functionality.

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[2]Chernikov, A., Berkelbach, T. C., Hill, H. M., Rigosi, A., Li, Y., Aslan, B., ... & Heinz, T. F. (2014). Exciton binding energy and nonhydrogenic Rydberg series in monolayer WS 2. Physical review letters, 113(7), 076802.

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