Weak Localization in Two Dimensional Transition Metal Dichalcogenide Flakes

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Introduction

The electrical isolation of atomically thin graphene in 2004 generated much excitement in the physics, nanotechnology, and engineering communities as it presented the opportunity to study an atomically thin two dimensional material [1]. This interest led to the discovery of rich physics such as the half-integer quantum hall effect [2, 3]. The success of graphene has prompted further interest in other atomically thin systems, including topological insulators [4] and more recently transition metal dichalcogenides such as MoS_2 [5-9]. Past studies of bulk transition metal dichalcogenides have revealed a diverse set of material properties, including metallic, semiconducting, and superconducting behavior [10]. However, as recent work demonstrating the indirect to direct bandgap transition in monolayer MoS_2 shows, the properties of these materials can significantly change when thinned to the atomic limit [5, 7]. With this motivation, we have studied magneto-transport in few-layer MoS_2 and few-layer $TaSe_2$ flakes and observed weak localization and weak anti-localization respectively.

Experimental Results

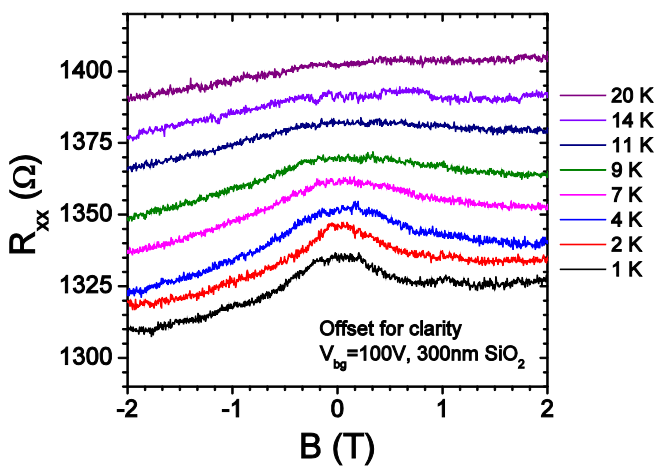

Figure 1: *Weak localization of few-layer MoS_2*

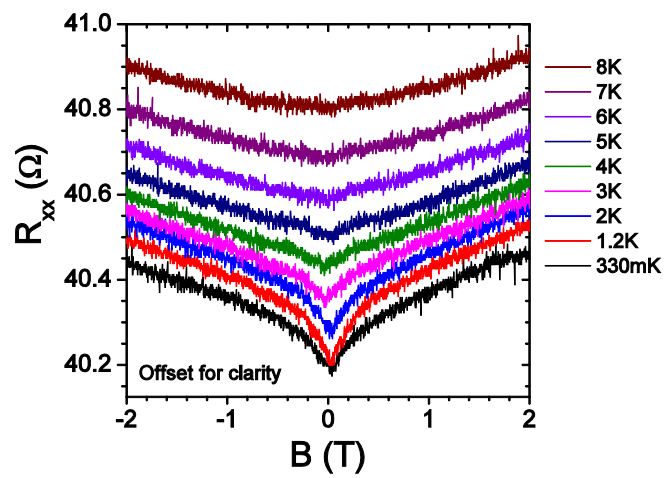

Figure 2: *Weak anti-localization of few-layer $TaSe_2$*

Magneto-transport measurements of few-layer MoS_2 and $TaSe_2$ flakes exfoliated onto insulating substrates were performed using SCM2 at NHMFL, Tallahassee, FL. **Figure 1** shows weak localization in a few-layer MoS_2 flake. Weak localization is observed at sufficiently high electron concentrations, and it persists as high as 11K. **Figure 2** shows weak anti-localization in a few-layer $TaSe_2$ flake, visible as high as 5K.

Conclusion

Weak localization and weak anti-localization have been observed in MoS_2 and $TaSe_2$, respectively, allowing us to probe electron coherence in these two dimensional materials.

Acknowledgements

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