Tuning electronic properties of transition-metal dichalcogenides

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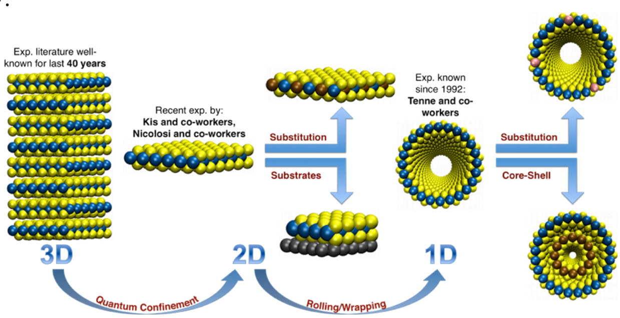
In 2011, transition-metal dichalcogenides (TMDs) have started their renaissance as potential materials for nano- and opto-electronics due to their extraordinary electronic properties arising from quantum confinement (exfoliation). Though known for over 40 years, bulk 3D TMDs are no threat to traditional silicon-based electronics. The situation has changed in 2011, when Nicolosi [1] and co-workers have shown that 3D TMDs are easy to process using liquid exfoliation and large-area single layers can be produced at low costs. Exfoliation to monolayers changes significantly electronic properties of TMDs. Kis and co-workers utilized this phenomenon and in the beginning of 2011 they produced the first field-effect transistor (FET) based on MoS_2 monolayer with mobility in the same range as for graphene nanoribbons and silicon thin films. [2] Shortly after, a logical circuits and amplifiers were produced. [3] Silicon-based FETs often suffer from heat dissipation. Therefore, to improve nanoelectronic devices one could replace silicon with materials that perform better at smaller scale, such as layered TMDs.

In this work, we have studied electronic properties of layered TMDs by means of quantum confinement, atomic substitutions, tube formation, layer stacking, and mechanical deformations. [4-6] Electronic and transport properties were investigated showing that the modifications mentioned above tune the electronic structure in a controlled way.



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