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Chemical Vapor Deposition Synthesis of Large-Area Monolayer InSe

Recently, two-dimensional materials of indium selenide (InSe) layers have attracted much attention from scientific community due to their high mobility transport and fascinating physical properties.[1-3] To date, reports on synthesis of high quality and scalable InSe atomic films have been limited. Here, we report that a synthesis of InSe atomic layers by vapor phase selenization of In_2O_3 in a chemical vapor deposition (CVD) system, resulting in large-area monolayer flakes or thin films.[4] The atomic films are continuous and uniform over a large area of 1 x 1 cm^2, comprising of primarily InSe monolayers. Spectroscopic and microscopic measurements reveal the highly crystalline nature of the synthesized InSe monolayers. The ion-gel-gated field-effect transistors based on CVD InSe monolayers exhibited n-type channel behaviors, where the field effect electron mobility values can be up to ~30 cm^2/Vs along with an on/off current ratio, of >10^4 at room temperature. In addition, the graphene can serve as a protection layer to prevent the oxidation between InSe and the ambient environment. Meanwhile, the synthesized InSe films can be transferred to arbitrary substrates, enabling possibility of reassembly of various two-dimensional materials into vertically stacked heterostructures, prompting research efforts to probe its characteristics and applications.

References

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Figures

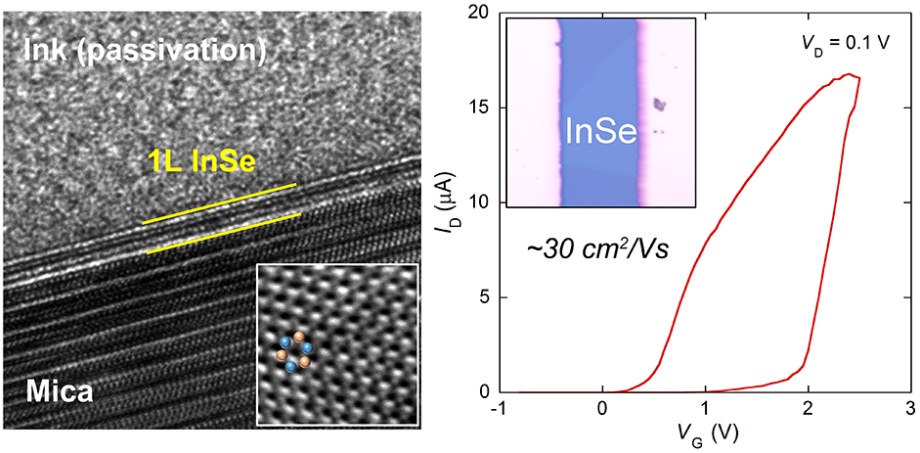

Figure 1: (Left) Cross-section TEM image of a monolayer InSe film, (Right) Linear scale transfer curve of the InSe FET.