Nobel Metal Based TMDCs – accessing semiconducting properties of PtSe$_2$ via Liquid Phase Exfoliation.

Beata M. Szydlowska, Zdenek Sofer, Georg S. Duesberg, Claudia Backes
Heidelberg Universitat, Applied Physical Chemistry, Heidelberg, Germany
Bundeswehr Universitat Munchen, Beata.m.Szydlowska@gmail.com

In a last decade, transition-metal-dichalcogenides (TMDCs) are receiving a significant attention due to their unique optical and physical properties both in fundamental research as well as potential applications in electronics, optoelectronics, catalysis, sensing etc. Platinum diselenide (PtSe$_2$), a recent member of TMDCs' group 10, according to DFT calculation undergo a transition from semi-metal to semi-conductor as it gets thinned down to monolayer exhibiting bandgap of 1.2 eV, 0.21 eV and no bandgap for monolayer, bi-layer, and tri- and more layer/bulk respectively. By now only few efforts were taken by the community in order to access predicted monolayer semiconducting properties of PtSe$_2$. Unfortunately, due to the structure resulting in extremally strong interlayer bonding, all only a few- layer PtSe$_2$ were reported to be so far isolated.

Here for the first time, we report successful isolation of bi- and mono-layered PtSe$_2$ nanosheets via Liquid Exfoliation method both in the water-based and solvent-based environment. Nanosheets of a different number of layers were extensively characterized by microscopic and spectroscopic techniques revealing the extremally high quality of LPE PtSe$_2$ while compared to TAC or CVD what is reflected for instance in much narrower Raman $E_g^1$ and $A_1g$ modes. Moreover, PtSe$_2$ poses exceptional ambient conditions stability and based on first tests exhibits extremally enhanced sensitivity and very short recovery times making it a very promising material to be applied in gas sensing.

References


Figures

**Figure 1:** AFM of PtSe$_2$ nanosheet.