Analysis of Nanocrystalline Structure and Electronic Properties in 2D Platinum Diselenide for Sensor Applications

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2D platinum diselenide ($PtSe_2$) is a layered transition metal dichalcogenide with promising properties for potential applications in electronics, photonics, and sensing.[1] Here, we present a thorough investigation of the structural and chemical composition of different samples grown by thermally assisted conversion (TAC) using Raman spectroscopy, transmission electron microscopy, and x-ray photoelectron spectroscopy.[2] We observe a strong correlation of the nanocrystalline structure with the extracted electronic properties, such as the sheet resistance, the extracted field-effect and Hall mobility, and the temperature dependence of the resistance. Additionally, we measure both positive and negative piezoresistive gauge factors across the different samples. Our findings provide indicators for tailoring and tuning the scalable, low-temperature TAC growth method[3] to enable the realisation of high-performance $PtSe_2$ devices, such as membrane-based sensors which could benefit especially from the high negative gauge factor.[4]

References

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Figures

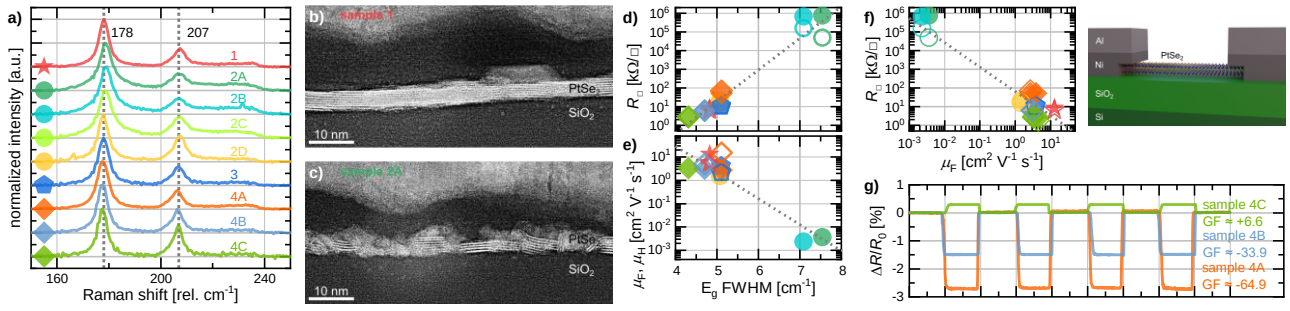

Figure 1: (a) Raman spectra of different $PtSe_2$ samples; (b-c) TEM image of two $PtSe_2$ samples with different electronic properties; (d-e) correlation between sheet resistance and mobility with the Raman E_g peak width; (f) correlation between sheet resistance and mobility; (g) piezoresistive gauge factor measurements of three $PtSe_2$ samples with strain varying between 0 and 0.04 %.