MBE growth of platinum diselenide on (0001) sapphire

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Platinum diselenide is nowadays getting a lot of attention for its excellent properties for optoelectronics [1, 2, 3], spintronics, valleytronics [4] or pressure sensors [5]. Thanks to its adjustable band gap (1.2 eV for the monolayer, 0.3 eV for the bilayer and zero bandgap for multilayers), high environmental stability [6], excellent electrical and optical properties [1] $PtSe_2$ is a promising candidate for mid-infrared electronic and optoelectronic devices.
Direct molecular beam epitaxy (MBE) of platinum diselenide on bilayer graphene/6H-SiC (0001) [4] and selenization of Pt (111) layers on Al_2O_3 (0001) [7] have been demonstrated.
We first studied the MBE growth of $PtSe_2$ on a (0001) sapphire substrate. As shown on Figure 1, the obtained Raman spectrum is characteristic of $PtSe_2$ and a record FWHM of 3.5cm^{-1} has been obtained for both E_g and A_{1g} peaks, indicating high crystalline quality [8], confirmed by the RHEED spectrum Figure 2. Figure 3 shows a TEM cross section image of 15 monolayers of PtSe2 grown on sapphire.
We will present the crystalline quality of the $PtSe_2$ film as a function of the substrate, studying SiO_2/Si, (0001) sapphire, bilayer graphene on SiC and GaN on sapphire, using Raman spectroscopy, transmission electron microscopy and in-plane X-ray diffraction to determine the epitaxial relationships between $PtSe_2$ and the substrate.

References

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Figures

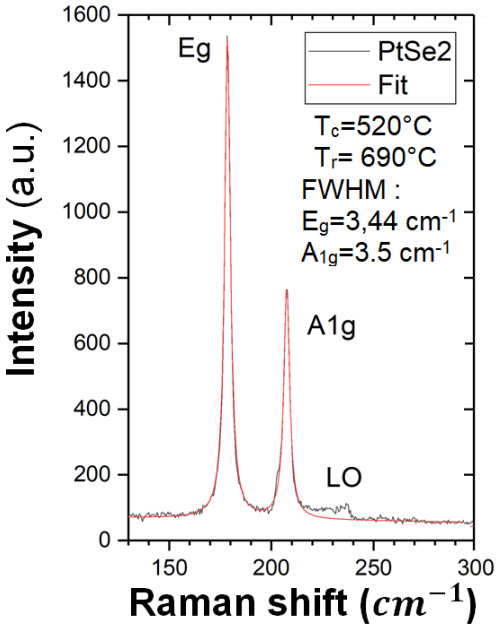

Figure 1: Raman spectrum of $PtSe_2$ film

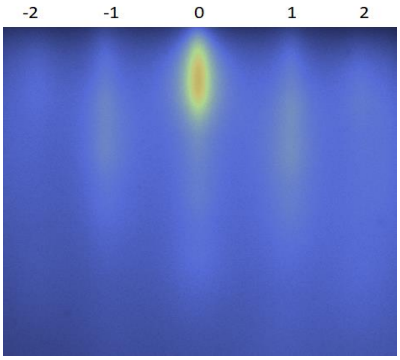

Figure 2: RHEED spectrum of $PtSe_2$ film

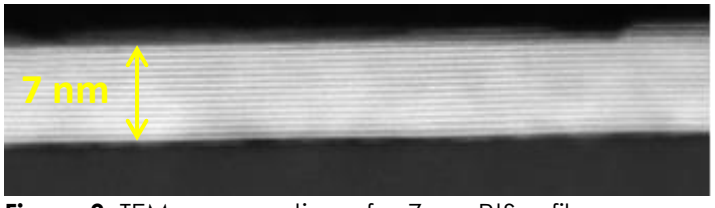

Figure 3: TEM cross section of a 7 nm $PtSe_2$ film grown on sapphire (0001)