Morphology and electric properties of oxidized $HfSe_2$ surface

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$HfSe_2$ is a layered material belonging to Transition Metal Dichalcogenides (TMDs) with a bandgap equal to 0.9 eV and 1.2 eV for bulk crystal and monolayer respectively [1]. It has one of the highest theoretically predicted carrier mobility μ (3500 $cm^2 \cdot V^{-1} \cdot s^{-1}$) among TMDs, however the experimentally measured values of μ are three orders of magnitude lower [1–4]. Such discrepancy arises from high contact resistance between $HfSe_2$ and measurement electrode, which ranges from 50 to 100 $k\Omega \cdot \mu m^{-1}$ [1]. $HfSe_2$ oxidizes under ambient conditions, which can drastically modify the potential barrier of metal/$HfSe_2$ interface, which in turn, can influence their contact resistance. Moreover, the morphology of Hf_xO_y could affect the effectiveness of the metal electrode contact to Hf_xO_y/$HfSe_2$.

The first part of this work is focused on the oxidation dynamics of $HfSe_2$ and the impact of oxidation parameters on the morphology of Hf_yO_x which forms on its surface. The time progression of Hf_xO_y growth was obtained in a quasi-controlled environment. The dependence of its morphology (surface roughness, the size of oxide structures) on the growth parameters has also been investigated using SPM and SEM techniques. The second part of this work concentrates on the procedure of fabricating devices with $HfSe_2$ active layer. Preliminary I/V measurements obtained for this type of device proved that the resistance of the Hf_yO_x/$HfSe_2$ structure decreased with increasing its exposure time to the ambient conditions. Additionally, an effective method of preventing the oxidation of $HfSe_2$ has been proposed and evaluated using Raman Spectroscopy.

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