# Ultra-high Quality Graphene Capped by Tungsten Disulfide

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Large-scale high mobility graphene devices are an interesting platform for a broad range of applications [1]. Current high (>$10^5$ $cm^2V^{-1}s^{-1}$) mobility graphene devices are based on hexagonal Boron Nitride (hBN)-encapsulated graphene [2]. However, large-scale growth of multi-layered hBN flakes has remained elusive [3]. Transition Metal Dichalcogenides (TMDs) have emerged as a valid encapsulation material for graphene [4]. Additionally, in contrast to hBN, many groups have demonstrated uniform growth of large-area TMD single [5] and multi-layer [6] films. In this work, we present the fabrication, the Raman characterization and the electrical characterization of TMD-capped graphene heterostructure. In particular, we analyse the mobility, the residual charge carrier concentration n*, as well as the Raman features of $WS_2$-capped graphene devices. Notably, the FWHM of the 2D peak of the graphene capped with top $WS_2$ were as low as ~15.5 $cm^{-1}$, with small variations (~0.8 $cm^{-1}$) indicating low strain fluctuations of the graphene layer. Using a rather thin ~10 nm TMD flake, we have achieved a room-temperature mobility of ~$1.4 \cdot 10^5$ $cm^2V^{-1}s^{-1}$ and n* of ~$6 \cdot 10^{10}$ $cm^2$. These data suggest $WS_2$ as a suitable capping material for graphene.

## References

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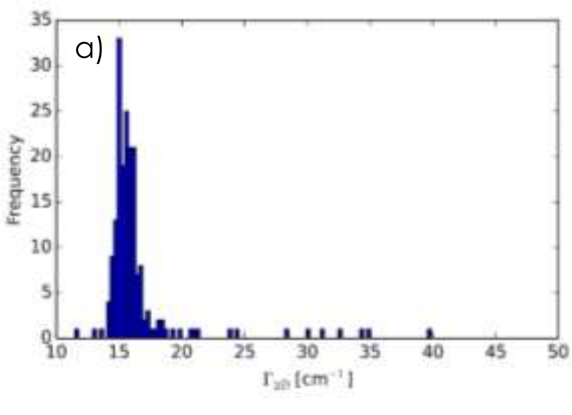
## Figures



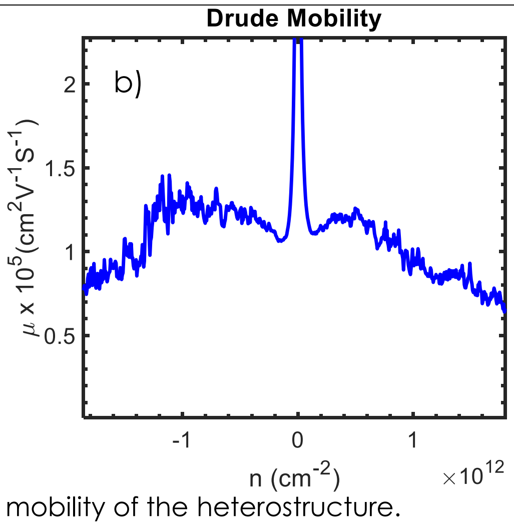




**Figure 1:** a) FWHM of the 2D peak b) the measured mobility of the heterostructure.