Low temperature synthesis of MoS_2 monolayers on glass

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After graphene, Transition Metal Dichalcogenides (TMD's) have gained huge importance due to their atomically-thin structure, electronic and optoelectronic properties. MoS_2 monolayer is a semiconducting material and has key importance in fabrication of nanoelectronic devices. Applications for flexible and wearable devices have increased the demand for nanoelectronics in transparent substrates. However, little is known about the synthesis of MoS_2 on transparent substrates due to temperature constraints. Here, we synthesised MoS_2 monolayers on glass for the first time using chemical vapour deposition (CVD). Normally TMD's are synthesized at relatively high temperature of about 800 ° C [1] and glass cannot reach such high temperature [2]. To reduce the growth temperature we added some Tellurium and mixed with MoO_3 powder. Te powder melts at low temperature and small fraction of MoO_3 also mixes with it which results in the growth of triangular monolayer's at relatively low temperature ~580 ° C. Tellurium addition is very important in this low temperature synthesis, as it forms an intermediate phase MoS_xTe_{2-x} and at the end Argon flow carries it away, which was further confirmed by the characterization of grown triangles [3].Further we investigate our samples with optical microscope, PL and Raman spectroscopy and AFM. The optical properties of these materials confirm its best crystalline shape, size, and thickness, see Fig.1 and Fig.2. The synthesis of TMD's on glass at low temperature will help in the study of transmission properties and in the low cost industrial synthesis of these semiconducting materials.

References

[1] Ismail Bilgin et al, ACS Nano(2015) VOL. 9 ' NO. 9 ' 8822–8832
[2] Jianyi Chen et al, JACS, (2017)
[3] Yongji Gong et al, ACS Nano, Issue (2015) 11658–11666.

Figures

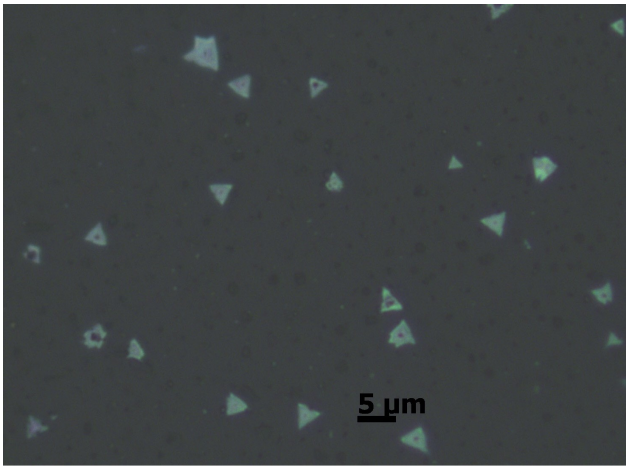

Figure 1: The optical image shows the triangular shape of MoS_2 monolayers on glass.

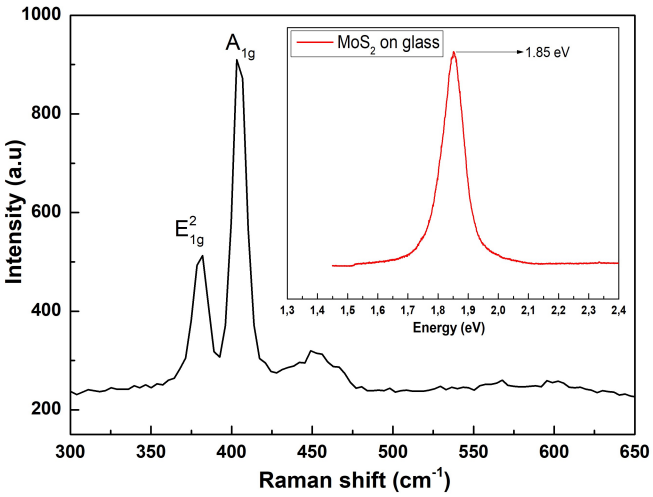

Figure 2: Raman spectra of MoS_2 monolayer excited by 473 nm laser, inset is the photoluminescence spectra of the same triangle.