Low temperature PEALD of MoS_2 on 200 mm glass and silicon dioxide coated silicon wafers

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The deposition of high-quality, large-area, uniform and continuous transition metal dichalcogenide (TMDC) films on an industrial scale is a major challenge, especially when complex and costly transfer methods are avoided.[1] Within this work, we report about the bottom-up fabrication of MoS_2 films on 200 mm glass and silicon dioxide coated silicon (SiO_2/Si) wafers. For this purpose, a low temperature PEALD process was successfully developed using bis(t-butylimido)bis(dimethylamino)molybdenum (Strem, 98 %) and hydrogen sulphide (99.5 %) as molybdenum and sulphur precursors, respectively.
Direct polycrystalline growth could be demonstrated without the use of additional H_2 to the plasma process gas, undesired additional growth promoters or time-consuming annealing steps.[2,3,4] This paves the way for an easy and less time-consuming integration of high-quality MoS_2 layers on an industrial scale even for flexible electronics on glass (Figure 1e)). Our process shows precise thickness control across the 200 mm wafers and a complete coverage, both on glass and SiO_2/Si wafers (Figure 1a), c)). The crystallinity of the films across the entire wafer is confirmed by Raman spectroscopy mappings (Figure 1b)). Topographic analysis by atomic force microscopy and scanning electron microscopy show closed layers, with a roughness of the 4 nm thick MoS_2 films on glass (*Rq* = 0.86 nm) even lower than on the SiO_2/Si wafers (*Rq* = 1.17 nm) (Figure 1d)).

References

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[4] Neubieser et al. *Micro Nano Eng* 15 (2022) 100126

Figures

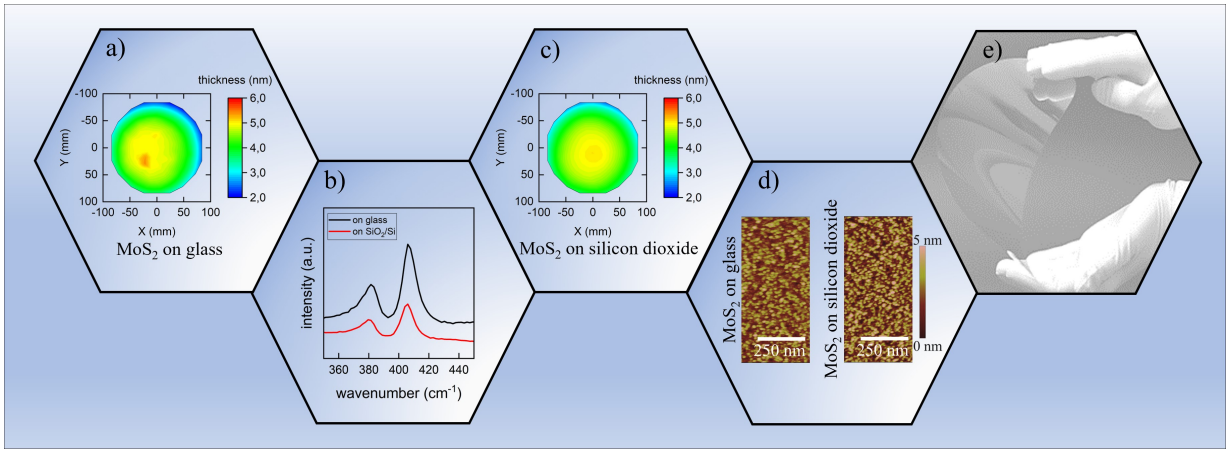

Figure 1 Schematic representation of the results of PEALD-grown MoS_2 on 200 mm wafers. Spectroscopic ellipsometry thickness mapping of MoS_2 on glass (a) and silicon oxide (c) wafers. Example Raman spectra of MoS_2 films in the wafer centre (b), AFM images of deposited MoS_2 films on glass and SiO_2 (d), and a bent 200 mm glass wafer (e).