# Full wafer-scale characterization method for 2D materials: on the way to 300 mm integration

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Uniform large-scale growth is one of the most important challenges for 2D integration in microelectronics devices. Recently, teams proved their capability to process 200 mm or 300 mm wafers of $MoS_2$ or $WS_2$ [1,2]. However, in most cases, only local characterizations are performed and data given are not representative of the whole wafer quality. Full size-wafer characterization is in that sense a key point to monitor the quality, homogeneity and defectivity for the growth and integration processes for large-scale applications.
This study is based on large scale characterization of $MoS_2$ grown on 200 mm Si/$SiO_2$ wafer in clean room [3]. Using wafer-scale tools, the whole wafer is characterized by Raman spectroscopy, photoluminescence, optical reflectance, defectivity and haze (surface scanning). These large-scale results are corroborated with small-area surface e.g. AFM, SEM, XRD…, to better understand them and to determine the most relevant parameters. With the help of software developed for wafer-scale tools and using data analysis, mapping can be performed for each of these five large-scale methods previously cited. The Figure 1 gives an example of one wafer characterized with four different large-scale methods. It exhibits that the quality is lower on the left edge with more defects in this area. The peak position in photoluminescence is linked to more defects as seen on defects analysis. This has been confirmed by SEM and AFM images. Thus, a non-destructive high-speed method, allowing mapping of 2D material at wafer scale in clean room, has been developed for 200 mm $MoS_2$ wafers and can be easily scaled up to 300 mm wafers.

References

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[2] Schram T, Sutar S, Radu I, Asselberghs I. Adv Mater. (2022) 2109796.
[3] Cadot S, Renault O, Frégnaux M, Rouchon D, Nolot E, Szeto K, et al. Nanoscale. ;9(2) (2017) 538-46.

Figures

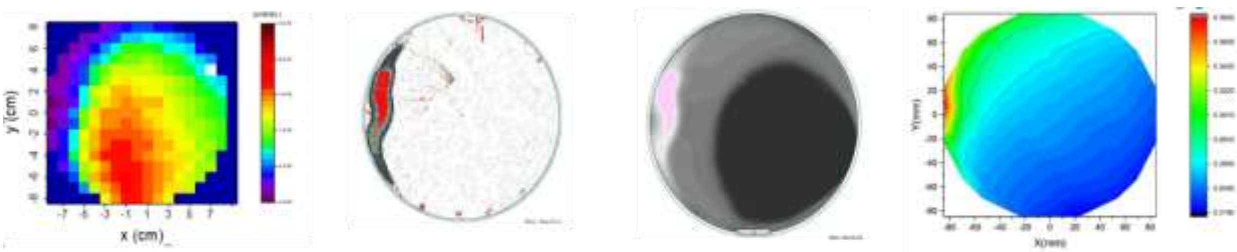


**Figure 1:** From left to right: mapping of $MoS_2$ 200 mm wafers by photoluminescence (peak position), defectivity, haze and optical reflectance at 249 nm