Thickness Mapping and Layer Number Identification of Exfoliated van der Waals Materials by Fourier Imaging Micro-Ellipsometry

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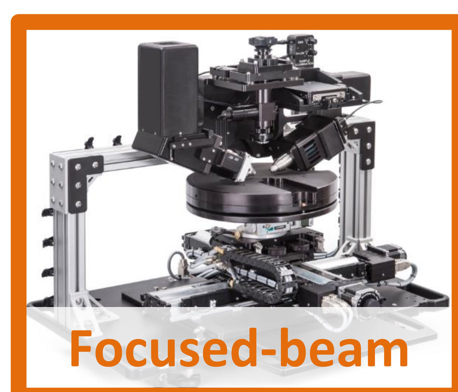
1) Spectroscopic Ellipsometry

- Optical technique for thin film characterization
  - Complex refractive index (n and k)
  - Thin film thickness (sub-angstrom accuracy)

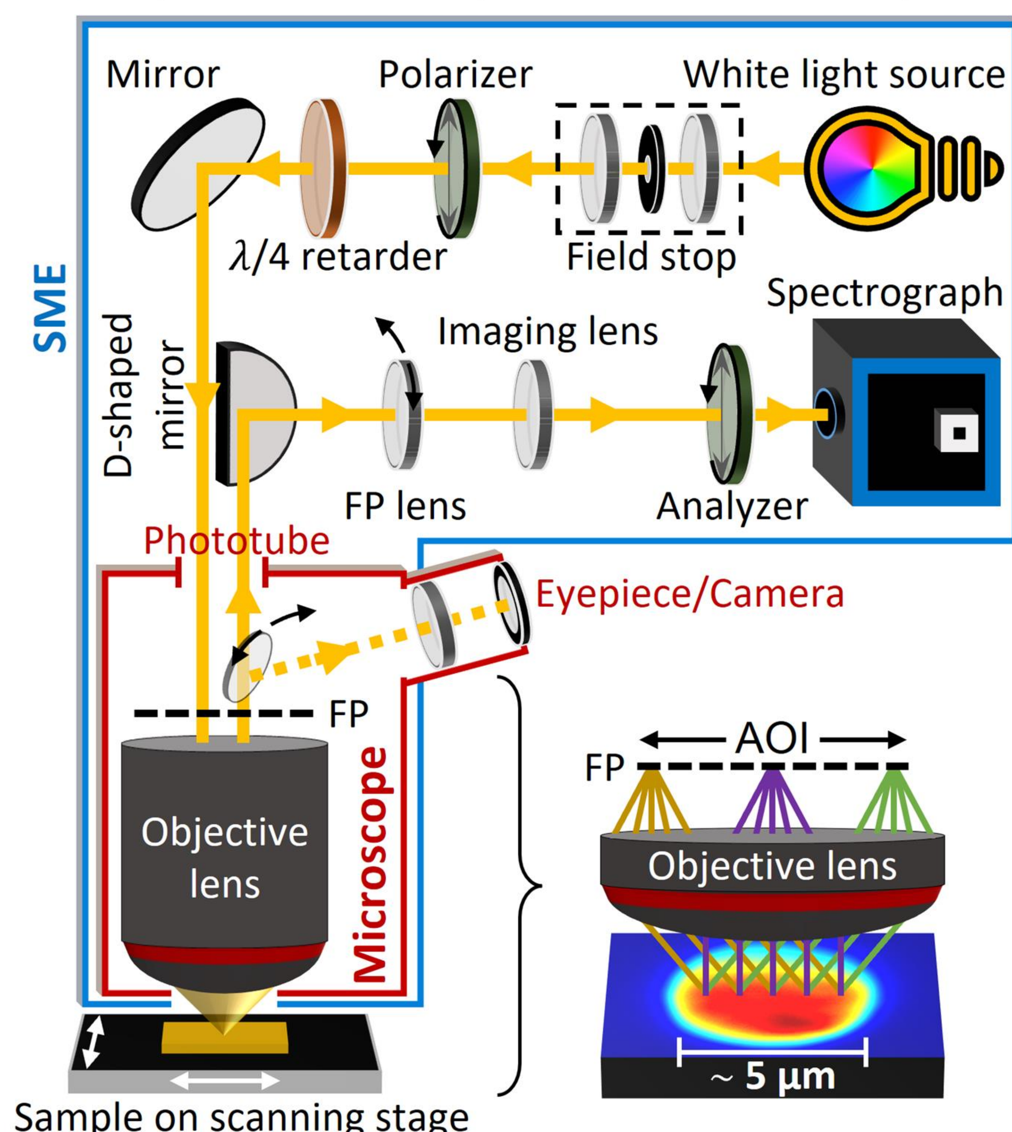
High lateral resolution Spectroscopic Ellipsometers



	Focused-beam		Imaging	
Lateral Resolution	Tens-of-µm	Low	A few µm	High
Data acquisition per measurement	Broadband, SINGLE angle	Low	SINGLE λ, SINGLE angle	Very low

Challenging to measure micro-structures

2) Spectroscopic Micro-Ellipsometer (SME)



- Patented technology **[1]**
- Proven performance **[2]**
- Microscope-integrated
- Fourier plane (FP) imaging

High lateral resolution

Up to 2 µm

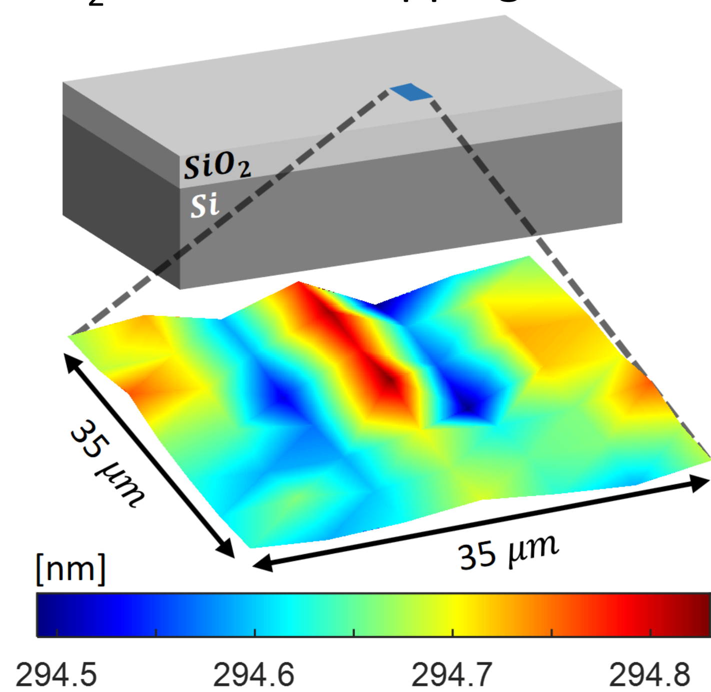
Record-high data acquisition per measurement

Broadband, MULTIPLE angles

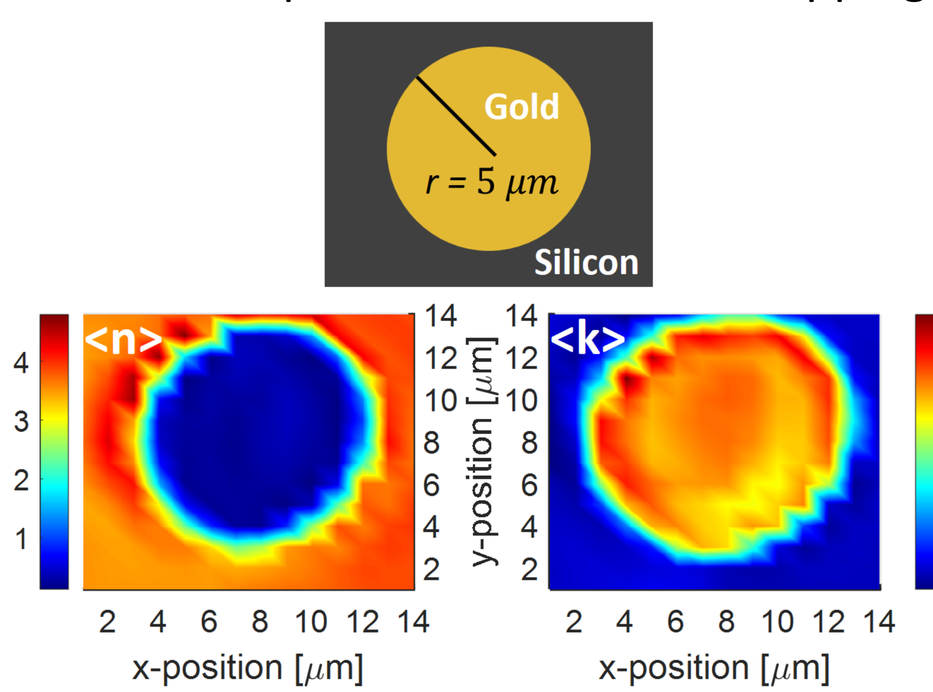
High accuracy & sensitivity

High lateral resolution mappings

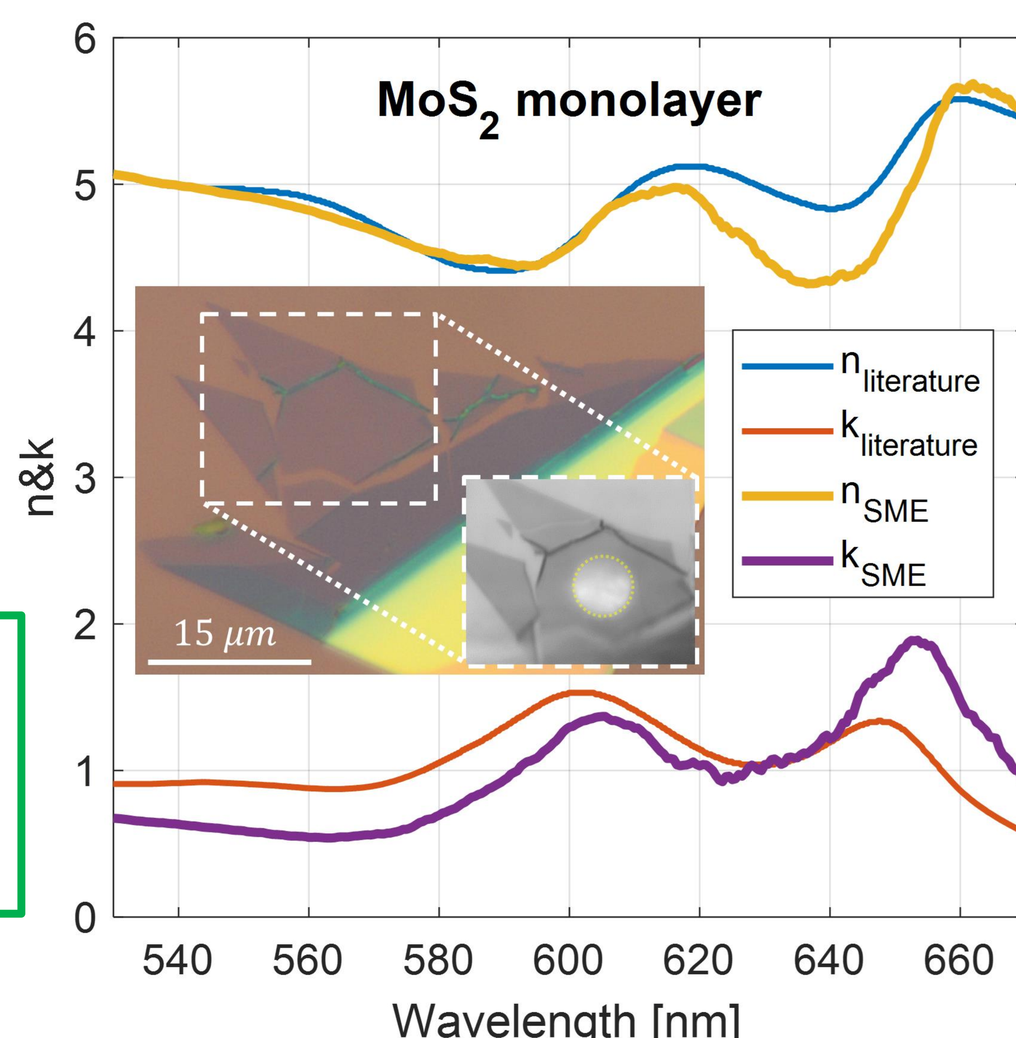
SiO_2 thickness mapping



Pseudo complex refractive index mapping

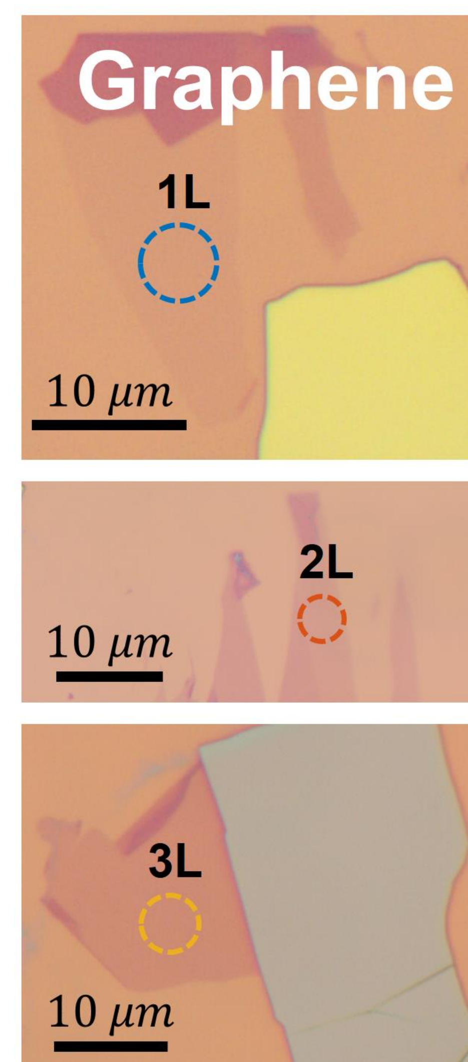


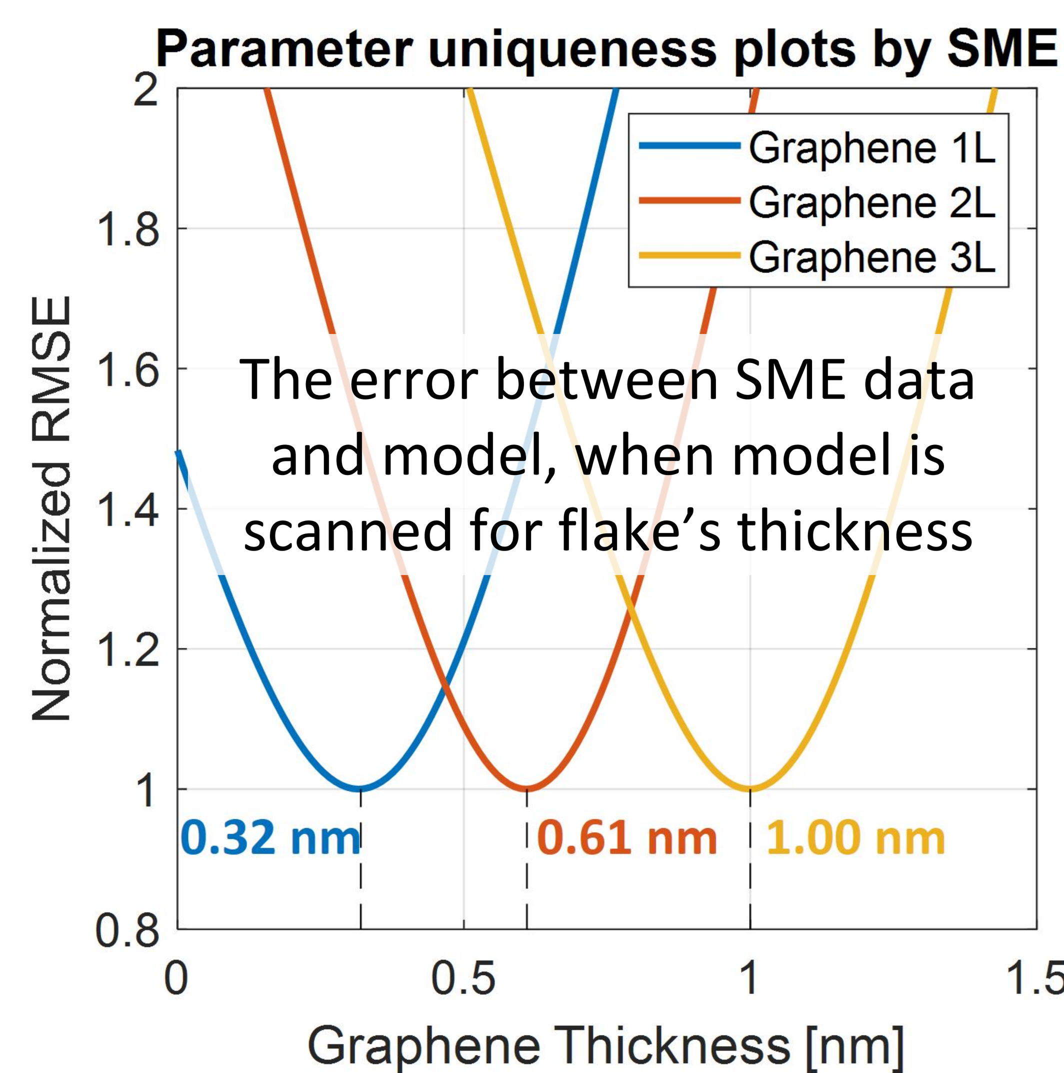
Complex refractive index of exfoliated MoS_2 monolayer



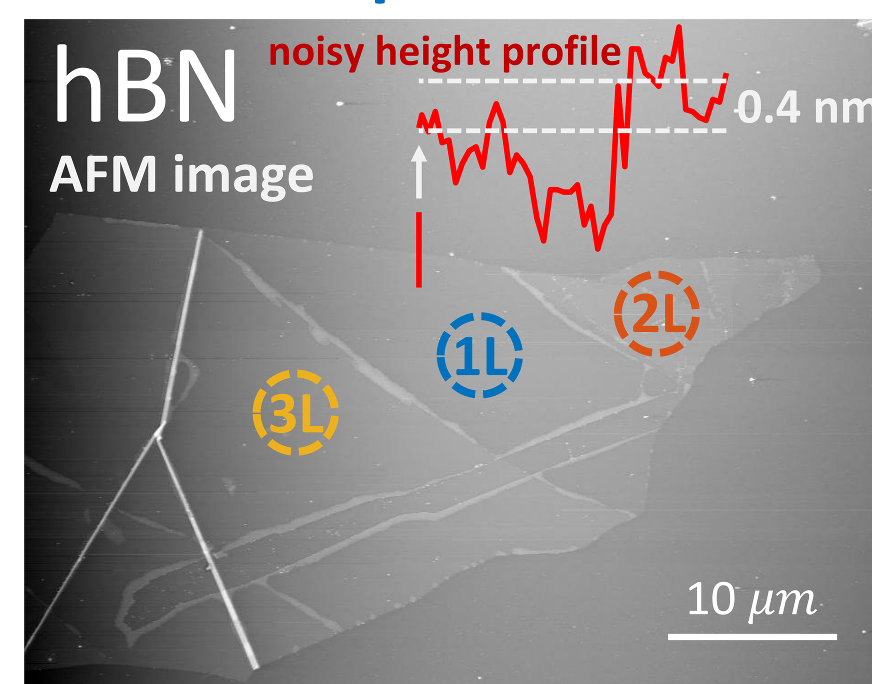
SME can quickly and accurately measure micro-structures

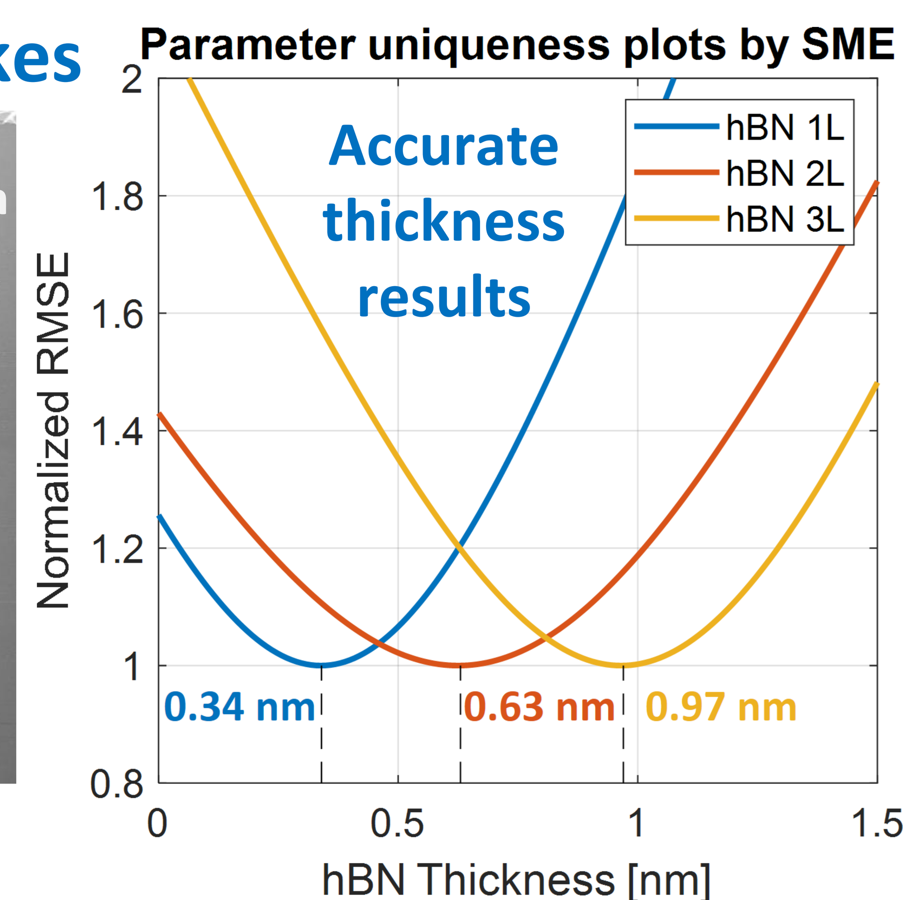
3) Thickness of exfoliated vdW materials [3]



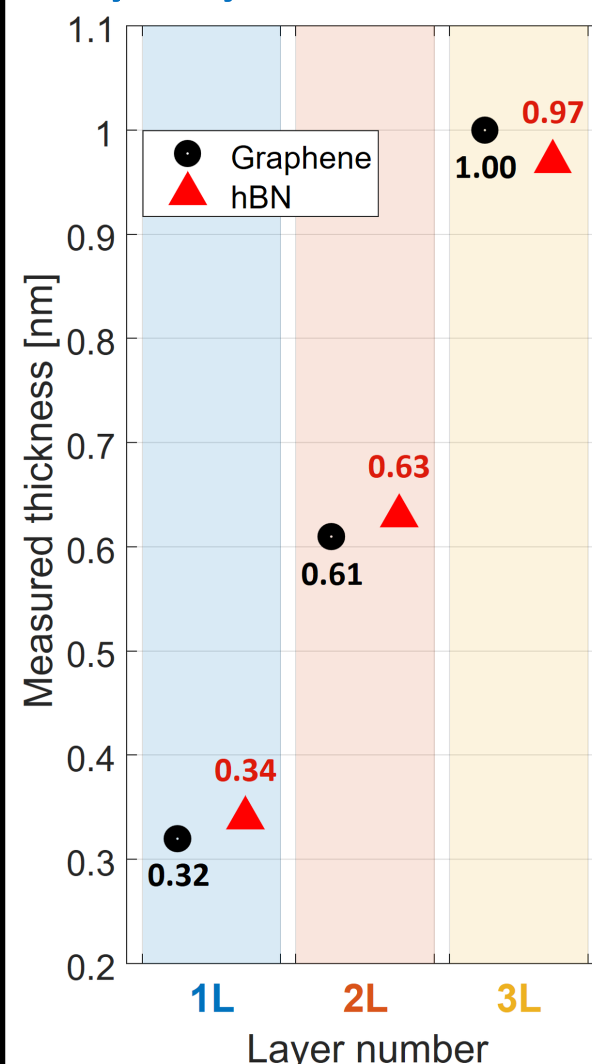


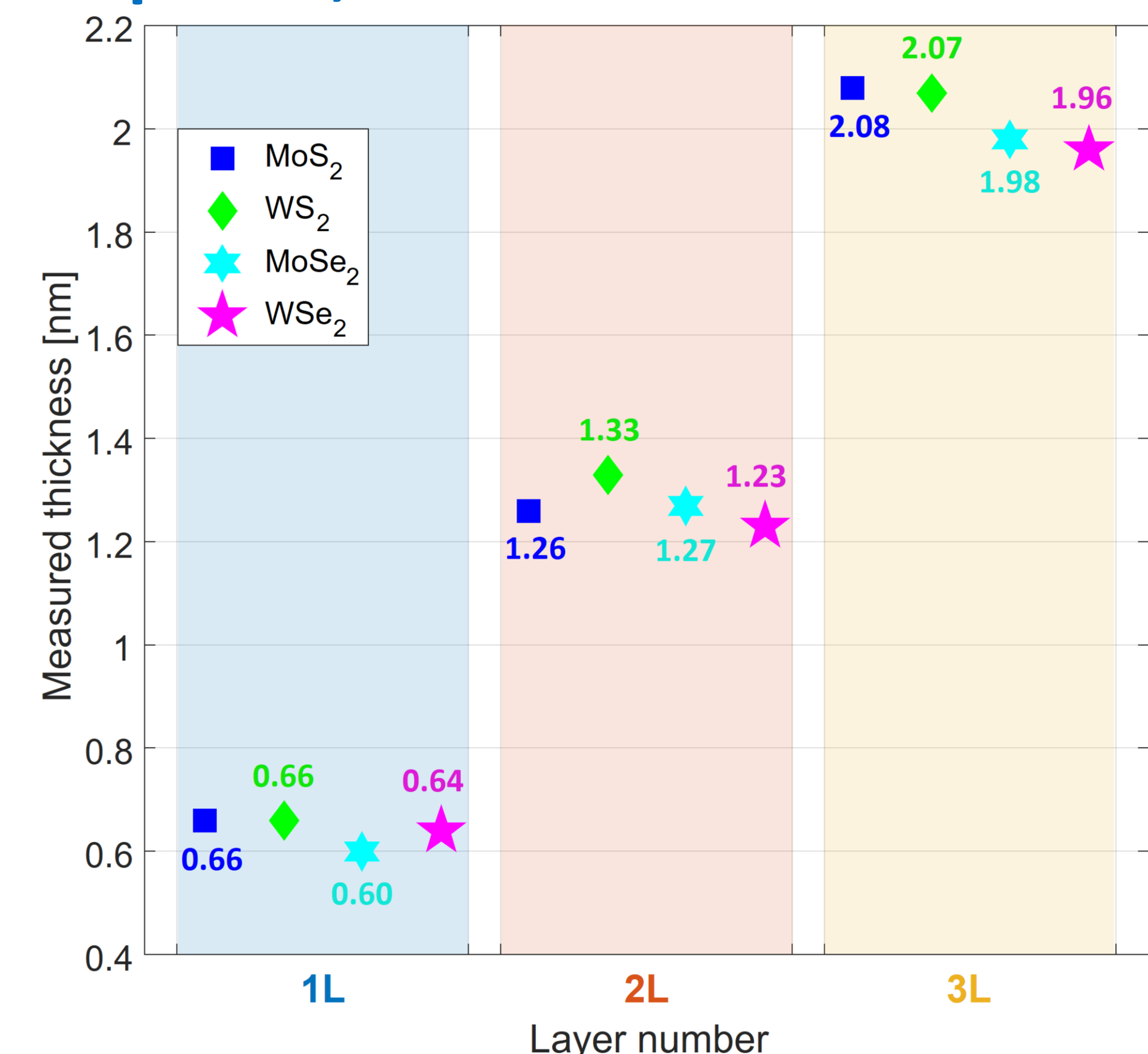
Near-transparent hBN flakes





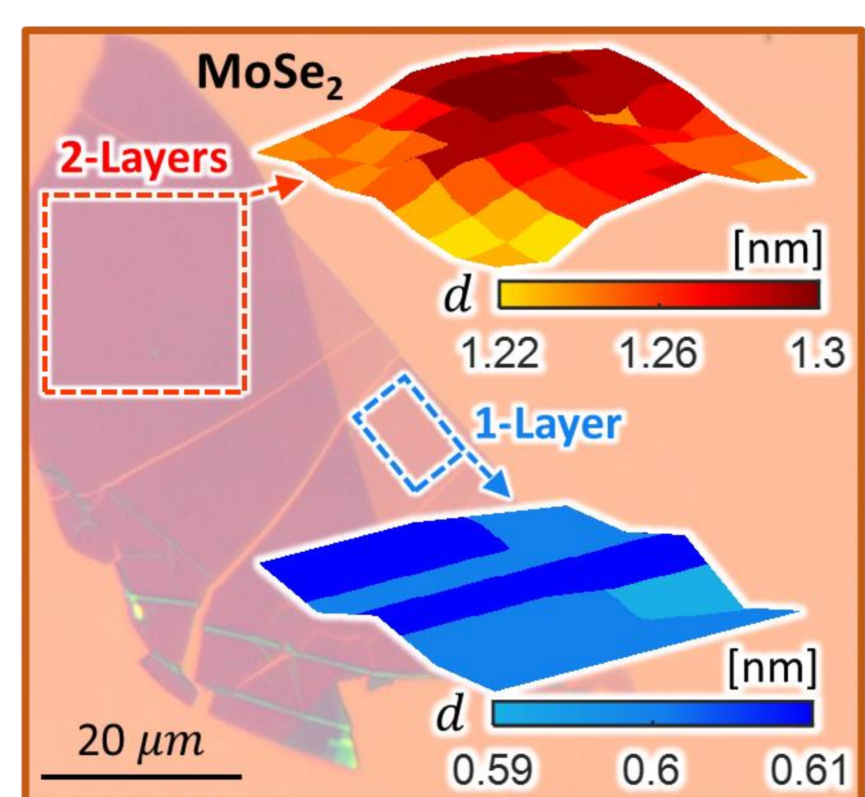
1L, 2L, 3L flakes of Graphene, hBN and TMDs





Thickness mapping on exfoliated $MoSe_2$ flake

Instrumental accuracy: ± **0.005 nm**



SME can accurately measure & map thicknesses of thin exfoliated 2D materials

References

[1] R. Kenaz and R. Rapaport, **United States Patent No. 11,262,293 B2** (2022).

[2] R. Kenaz and R. Rapaport, **Review of Scientific Instruments 94, 023908** (2023).

[3] R. Kenaz et al., **ACS Nano 17, 9188-9196** (2023).

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