Revisiting the Buckling Metrology Method to Determine the Young's Modulus of 2D Materials

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The exceptional mechanical properties of 2D materials are one the main reasons for the large interest of the scientific community in this class of materials. Unfortunately, despite normal electrical and optical probing techniques are suitable even for these atomically thin materials, conventional mechanical tests are not suitable to probe their mechanical properties. In our work, we use the buckling metrology method, which is a simple yet powerful technique that originally has been developed to measure the mechanical properties of thin organic films [1]. Using this technique, we determine the Young's modulus of several transition metal dichalcogenides (MoS_2, $MoSe_2$, WS_2, and WSe_2) with thicknesses ranging from 2 to 10 layers [2]. The obtained values for the Young's modulus and their uncertainty are critically compared with previously published results, finding that this simple technique provides results which are in good agreement with those reported using other highly sophisticated testing methods. The fast and easy implementation of the buckling metrology allows also to investigate the Young's modulus of environmentally unstable materials such as black phosphorous or GaSe, and to study the influence of degradation on their mechanical properties. [3-4]

References

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Figures

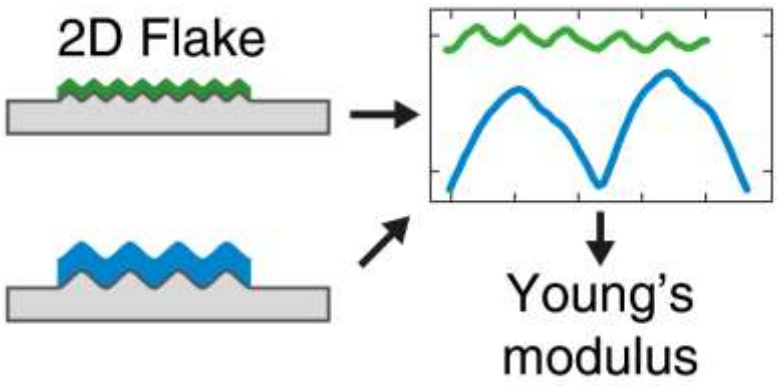

Figure 1: The spontaneous formation of periodic wrinkles is due to the buckling instability that occurs in thin 2D flakes deposited onto a prestrained relatively soft, thick substrate. Using the spacing of the periodic wrinkles one can calculate the 2D material in-plane elastic modulus by applying well-established buckling mechanics equations.