Automated Search For TMDs Monolayers On Exfoliated Samples

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Despite the constant development of the transition metal dichalcogenide (TMD) monolayer fabrication methods, the exfoliated TMD flakes still exhibit the best optical properties. However, by its nature, exfoliation is pretty much a random process, which results in a chaotic distribution of different multilayers on the substrate's surface. The search for monolayers suitable for further processing and measurements is often mostly done manually, which is tedious and time-consuming due to monolayers' size. It turns out that using simple optical properties and computer calculations can significantly speed up this process.

Thin TMD multilayers of different thicknesses deposited on a reflective substrate, such as a silicon wafer, reflect the white light differently due to internal interferences and absorption within the TMD material (Fig. 1). Because of this effect, it is possible to assess the number of layers in a given flake by eye test using an optical microscope with a white light source. By analysing images of silicon wafers covered in exfoliated TMDs, one can select monolayer flakes and, by further analysis of their size and shape, find samples usable for purposes such as fabricating heterostructures.

In this presentation computer program capable of such identification will be shown. The software can find monolayers from saved images of exfoliated TMDs. Statistical analysis of previously found monolayers allows the algorithm to locate monolayers on photos taken under different conditions, such as differing exposure time or light intensity. The scope of this program's usability is also easily expandable to other layered materials.

The main advantages of that approach over manual search are the significantly shorter time required to search through the entire surface of the wafer and the nearly complete elimination of the chance of missing a good flake. It also potentially outperforms other deterministic methods of finding monolayers, such as PLE measurement, because of accessibility, as it does not require any additional experimental setup other than a microscope with a camera.

The presentation will cover statistical analysis used to determine the colour of monolayers in a given image alongside the main coding ideas used in the software.

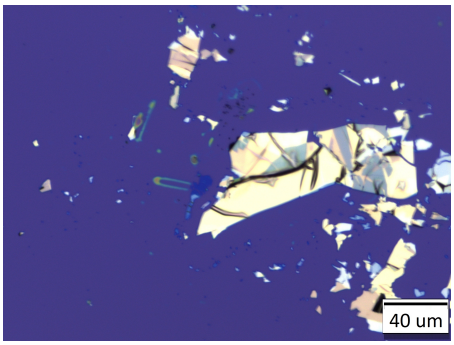

Figure 1: A microscope image of the exfoliated WSe_2 on the silicon substrate. Layers of different thicknesses have distinctively different colours. The orange and yellow are the thickest, while the dark blue spot near the centre of the image is a monolayer.