Quantitative optical mapping of two-dimensional materials

The pace of two-dimensional materials (2DM) research has been greatly accelerated by the ability to identify exfoliated thicknesses down to a monolayer from their optical contrast. Since this process requires time-consuming and error-prone manual assignment to avoid false-positives from image features with similar contrast, efforts towards fast and reliable automated assignments schemes is essential. We show that by modelling the expected 2DM contrast in digitally captured images, we can automatically identify candidate regions of 2DM. More importantly, we show a computationally-light machine vision strategy for eliminating false-positives from this set of 2DM candidates through the combined use of binary thresholding, opening and closing filters, and shape-analysis from edge detection. Calculation of data pyramids for arbitrarily high-resolution optical coverage maps of two-dimensional materials produced in this way allows the real-time presentation and processing of this image data in a zoomable interface, enabling large datasets to be explored and analysed with ease. The result is that a standard optical microscope with CCD camera can be used as an analysis tool able to accurately determine the coverage, residue/contamination concentration, and layer number for a wide range of presented 2DMs.