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Nanomanufacturing - Key control characteristics - Part 6-24: Graphene-related products - Number of layers of graphene: optical contrast

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INTRODUCTION

Graphene, as a pioneer of 2D materials, plays a critical role in many state-of-the-art applications, extensively involving electronics, optoelectronics, sensors, and energy storage. [1][1] Graphene has many desirable properties, e.g. high carrier mobility, broadband optical absorption, biocompatibility and excellent stability and hence has good prospects not only for basic research but also for various industrial applications. Large-area graphene film fabricated by chemical vapour deposition (CVD) method is one of the most promising candidates for commercialization. However, large-area CVD graphene films typically contain multilayer domains that occupy varying proportions of the surface area, which can significantly affect their electrical, mechanical and optical properties. Therefore, it is crucial to quantitatively assess number of layer distribution (i.e. the area proportions for various layer domains) in CVD graphene films for both research and application development.

There are many approaches for measuring number of layers of graphene films, such as transmission electron microscopy (TEM), Raman spectroscopy, optical microscopy, and atomic force microscopy (AFM). However, how to measure number of layer distribution is not specified yet. This will affect application development and commercialization of large-area CVD graphene film.

This document specifies a simple, high-throughput, and non-destructive approach to measure number of layer distribution of large-area CVD graphene film by optical contrast method. The basic principle and experimental approach of the optical contrast method are presented to identify number of layer distribution. This method relies on the statistical analysis of the optical contrast values of the pixels that make up the sample's optical images, and it is significantly more efficient than TEM, AFM and Raman spectroscopy characterization method. With light illumination corrections, the coverage ratio of monolayer and multilayer domains in large-scale CVD graphene can be obtained accurately.

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[1] Numbers in square brackets refer to the Bibliography.