# Intelligent identification of two-dimensional nanostructures by machine-learning optical microscopy

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Abstract

Two-dimensional (2D) materials and their heterostructures, with wafer-scale synthesis methods and fascinating properties, have attracted significant interest and triggered revolutions in corresponding device applications[1-3]. However, facile methods to realize accurate, intelligent, and large-area characterizations of these 2D nanostructures are still highly desired. Herein, we report the successful application of machine-learning strategy in the optical identification of 2D nanostructures. The machine-learning optical identification (MOI) method endows optical microscopy with intelligent insight into the characteristic color information of 2D nanostructures in the optical photograph. The experimental results indicate that the MOI method enables accurate, intelligent, and large-area characterizations of graphene, molybdenum disulfide, and their heterostructures, including identifications of the thickness, existence of impurities, and even stacking order. With the convergence of artificial intelligence and nanoscience, this intelligent identification method can certainly promote fundamental research and wafer-scale device applications of 2D nanostructures.

References

[1] Lin, X., Si, Z., Fu, W., Yang, J., Guo, S., Cao, Y., Zhang, J., Wang, X., Liu, P., Jiang, K. & Zhao, W., **Nano Res.** 11, 6316-6324 (2018).

[2] Lin, X., Su, L., Si, Z., Zhang, Y., Bournel, A., Zhang, Y., Klein, J., Fert, A. & Zhao, W., **Physical Review Applied** 8, 034006 (2017).

Figures

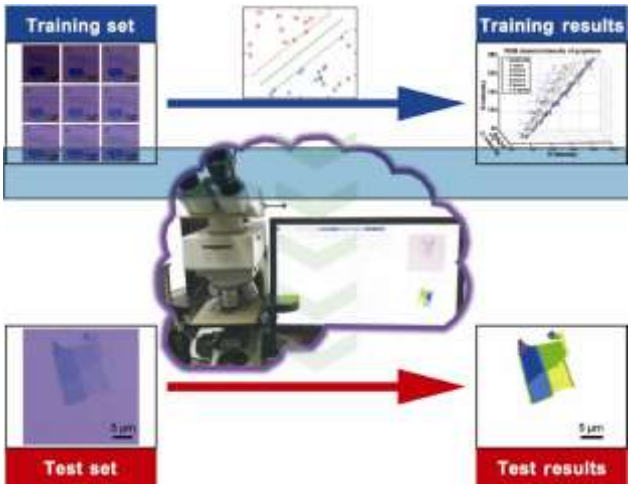


**Figure 1:** Schematic illustration and photograph of the machine-learning optical identification ( MOI ) system.

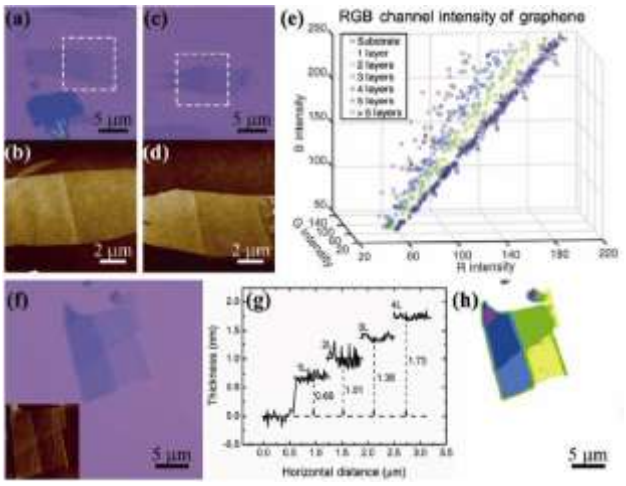


**Figure 2:** MOI of graphene samples.