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Coating two-dimensional MoS_2 with polymer creates a corrosive non-uniform interface

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Abstract

Two-dimensional (2D) materials and soft materials are both susceptible to mechanical instabilities, such as buckling, wrinkling, folding and creasing, especially when located on surfaces. Here, we report that weak van der Waals interactions cause the interface between 2D molybdenum disulphide (MoS_2) and a soft poly(methyl methacrylate) (PMMA) coating to demonstrate mechanical instability and delamination. The resulting non-uniform and buckled interface greatly hampers the ability of the coating to protect the MoS_2 substrate. Also, the corrosion rate of 2D MoS_2 and quench rate of intrinsic luminescence in 2D MoS_2 were significantly accelerated by the soft coating. Owing to the formation of corrosive cavities at the interface, the geometry and size of the flakes became the dominating factor, and a critical size of 2D flakes for such interfacial instability was determined based on elasticity theory. Such hazardous corrosion in a 2D material caused by a soft coating raises concern for their use in electronic packaging, and for the processing of van der Waals-layered materials for future applications.

References

[1] Q. H. Thi, H. Kim, J. Zhao & T. H. Ly, npj 2D Materials and Applications, 2: 34 (2018).

Figures

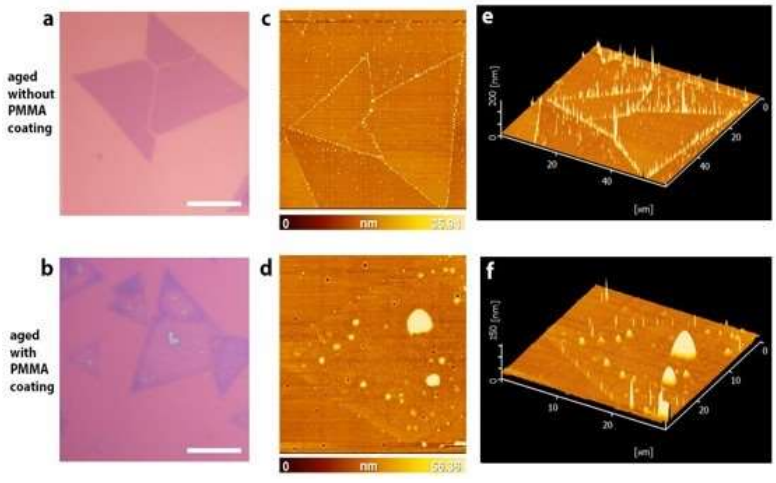

Figure 1: The comparation of aging effect on bare and PMMA-coated 2D MoS_2 for 1 month in ambient condition.