Songfeng Pei
Kun Huang, Wencai Ren, Hui-Ming Cheng
Institute of Metal Research, Chinese Academy of Sciences, Shenyang, China

sfpei@imr.ac.cn

Mass production of graphene and its application for functional anti-corrosive coatings

Mass production of high-quality graphene materials in a cheap way is an important prerequisite for the application of graphene. Graphene oxide (GO) has been investigated as a chemical alternative for mass production of graphene. However, GO is defective and requires reduction. The original graphene structure from GO cannot be efficiently restored, which results in the degradation of properties of graphene. Furthermore, the production and reduction processes of GO use a large amount of strong oxidants, condensed acids and toxic reducing agents, which are harmful to environment and hard to be safely treated.

We resolved these problems by developing a new approach to produced graphene through an "Intercalation-Exfoliation" way. Graphite particles were firstly intercalated to form graphite intercalation compound (GIC), then the intercalate can react with an liquid reagent to produce gases within the intercalated layers of GIC and exfoliate them into graphene slices dispersed in solvent. No destrustive effect to graphene sheets is present in the whole process, which preserves the original properties of graphene both structurally and chemically (see Fig. 1), and the electrical conductivity of a thin film assembled with the graphene sheets is higher than 800 S/cm. Based on this method, a production line with an annual output of 30 tons has been put into production.

The graphene sheets can be used in many fields, for example, in anti-corrosion coatings. It is found that graphene/epoxy coatings show improved anti-corrosion performance due to the excellent barrier effect of graphene sheets. In comparison with the conventional carbon black coatings, the grpahene/epoxy coatings with a low graphene content (<2 wt%) have a lower water absorption (1/5) and a much lower ion permeability rate (1/200). The barrier effect relies on the impermeability and high aspect ratio (10^3~10^4) of graphene sheets as well as good dispersion in polymer matrix. Further, for the high electrical and thermal conductivity of graphene sheets, the composite coatings also show excellent functional properties like electro-thermal heating, antifouling by electrolysis and heat dissipation. The applications of the graphene based functional anti-corrosive coatings will be reported.

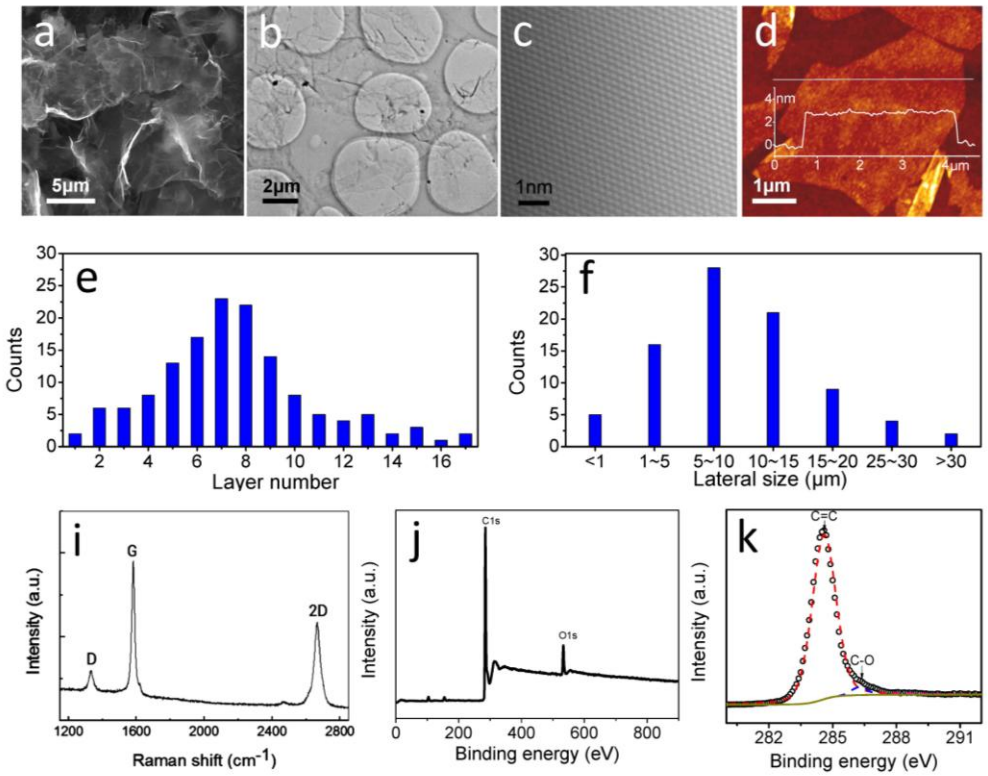

Figure 1: Typical morphologies and properties of graphene flakes synthesized from FGIC. (a) SEM, (b, c) HRTEM, (d) Raman, (e) XPS survey, (f) XPS C1s spectrum with peak split, (g) AFM, (h) statistics of thickness distribution of graphene sheets, (i) statistics of lateral size distribution of graphene sheets.