“Snowing” graphene using microwave ovens

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Abstract

An extremely simple process is presented for synthesizing high quality graphene at low-cost in the gas phase, similar to “snowing,” which is catalyst-free, substrate-free, and scalable. This is achieved by utilizing corona discharge of SiO_2/Si in an ordinary household microwave oven at ambient pressure. High quality graphene flakes can “snow” on any substrate, with thin-flakes even down to the monolayer. In particular, a high yield of ≈6.28% or a rate of up to ≈ 0.11 g h^{-1} can be achieved in a conventional microwave oven. It is demonstrated that the snowing process produces foam-like, fluffy, 3D macroscopic architectures, which are further used in strain sensors for achieving high sensitivity (average gauge factor ≈ 171.06) and large workable strain range (0%–110%) simultaneously. It is foreseen that this facile and scalable strategy can be extended for “snowing” other functional 2D materials, benefiting their low-cost production and wide applications.

References

[1] Y. Y. Sun, L. W. Yang, K. L. Xia, H. Z. Liu, D. Han, Y. Y. Zhang,* J. Zhang*, Adv. Mater., 30 (2018), 1803189

Figures

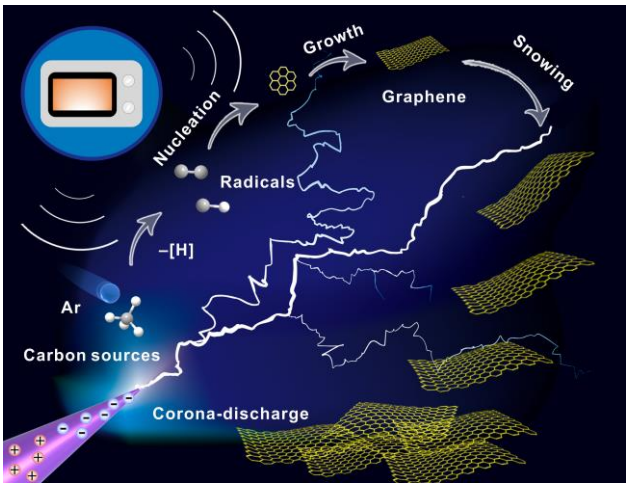

Figure 1: Schematic illustration of growing graphene using a conventional microwave oven.

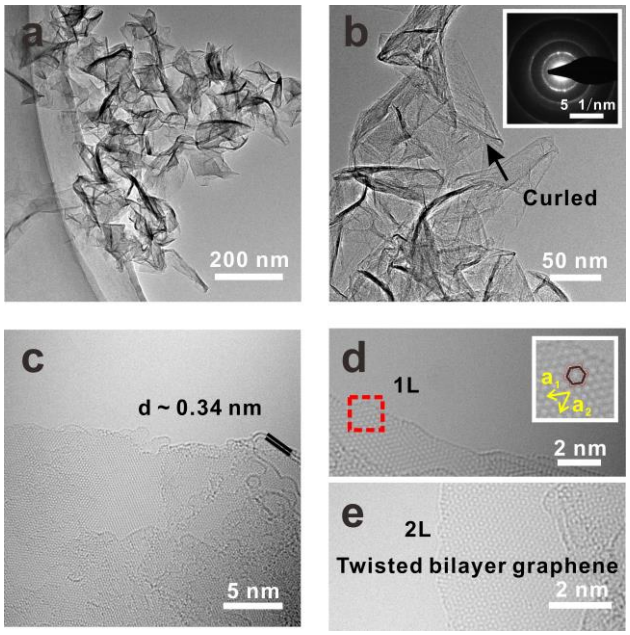

Figure 2: a,b) Low-magnification TEM image and selected-area electron diffraction pattern (as an inset) of graphene. c–e) Low-voltage, aberration-corrected, high-resolution TEM image of graphene layers and the edges of single layer and two layers. An enlarged area derived from the red box in inset (d) is shown as an inset, exhibiting the six-fold symmetry.