Three-Dimensional Few-Layered Graphene Bubble-Networks Fabricated by Substrate-Free Polymer-Based Graphitization

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Abstract

Three-dimensional (3D) designed graphene architectures are most desired to bring all the extraordinary nanoscale properties of individual graphene flakes to macroscopic graphene assemblies for realizing practical applications in the macro-world. However, current 3D graphene products still suffer from poor electrical conductivity, low surface area, and insufficient mechanical strength/elasticity; the interconnected self-supported reproducible 3D graphenes remain unavailable. Here, we report a novel "sugar blowing" approach based on a polymeric predecessor to synthesize a new 3D graphene bubble-network, *i.e.* strutted graphene (SG). SG consists of mono- /few-layered graphitic membranes tightly "glued", rigidly fixed and spatially scaffolded by micrometer-scale graphitic struts. Such topological configuration provides intimate structural interconnectivities, freeway for electron/phonon transports, huge accessible surface area, as well as robust mechanical properties. SG thus overcomes the drawbacks of all presently available 3D graphene products and opens up a wide horizon for diverse practical usages, *e.g.* high-power high-energy electrochemical capacitors.[1]

References

[1] X.B. Wang, Y.J. Zhang, C.Y. Zhi, X. Wang, D.M. Tang, Y.B. Xu, Q.H. Weng, X.F. Jiang, M. Mitome, D. Golberg & Y. Bando, *Nat. Comm.* **4** (2013) 2905.

Figures

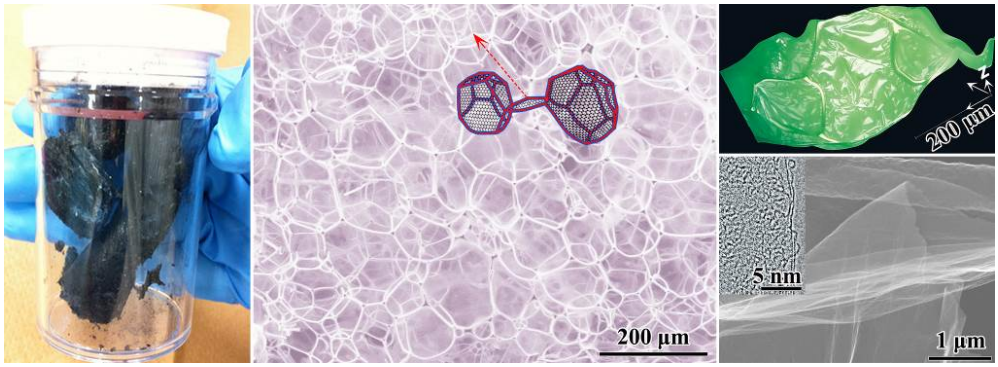

Figure 1. (left) A 70-mg SG piece and corresponding SEM image; (right) Optical photo and amplified SEM as well as high-resolution TEM images. The inserted reconstructed topology corresponds to the region marked in red for the two connected decahedron-dodecahedron bubbles faced by 8 pentagons and 2 quadrangles, and by 8 pentagons, 3 quadrangles, and 1 heptagon respectively.