Imaging and Diffraction of 2D Polymers

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One of the key challenges in 2D materials is to go beyond graphene, a prototype 2D polymer, and to synthesize its organic analogs with structural control at the atomic- or molecular-level [1]. Here, we report the TEM investigations of the 2D polyimide (Fig. 1) which is synthesized through Schiff-base condensation reaction at the air-water interface. By using selected-area electron diffraction and aberration-corrected high-resolution TEM imaging (Fig. 2), the molecular structure of the synthesized 2D polyimide has been clearly identified. Due to the irradiation-sensitive nature of the 2D polymer, low-dose technique has been applied to reduce the electron beam damage allowing precise determination of the pristine lattice structure, single-crystalline domain size as well as grain boundary structures. Our work not only paves the way for the rational design of functional 2D polymers but also demonstrates the great potential of TEM techniques in structural analysis of synthesized 2D polymers.

References

[1] H. Sahabudeen, H. Qi, B.A. Glatz, D. Tranca, R. Dong, Y. Hou, T. Zhang, C. Kuttner, T. Lehnert, G. Seifert, U. Kaiser, A. Fery, Z. Zheng and X. Feng, Nature Communications, 7 (2016) 13461

Figures

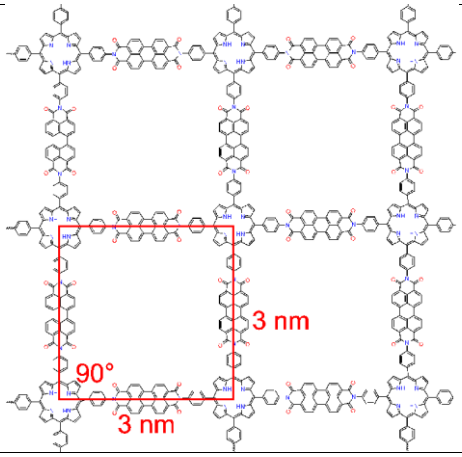

Figure 1: Atomic structure of the 2D polyimide with square lattice.

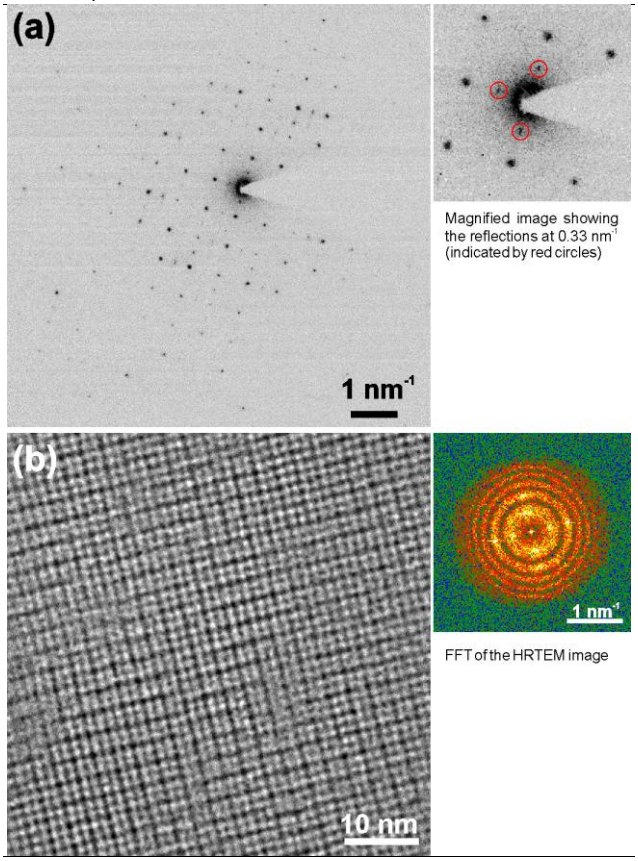

Figure 2: (a) Low-dose selected-area electron diffraction pattern demonstrating the cubic symmetry of the 2D polyimide. The first order reflections are found exactly at 0.33 nm^{-1}, confirming the lattice parameter of 3 nm. (b) Low-dose HRTEM image and its corresponding FFT showing clearly the square lattice of the synthesized 2D polyimide.