# One step hydrothermal synthesis of nitrogen, boron co-doped graphene

INCDTIM

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## Introduction

**In this work, we synthesized nitrogen and boron co-doped graphene by one step co-doping using the hydrothermal method with graphene oxide (GO), urea and boric acid as the carbon precursor and heteroatom sources. The effect of the reaction time, temperature and the GO: urea: boric acid ratio was thoroughly investigated by SEM, X-Ray powder diffraction, Raman and XPS. The influence of nitrogen and boron co-doping on the morphology, structure, and composition of the NB-Gr was systematically investigated.**

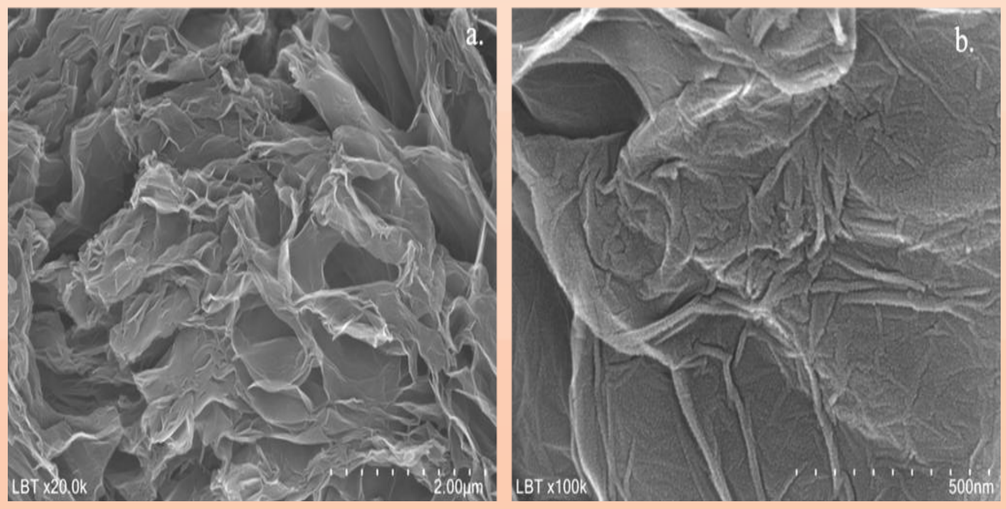
## Experimental

**Typically, an appropriate amount of doping agents (70, 700 or 1000 mg) was added to 120 mL aqueous dispersion of GO (700 mg), previously sonicated for 1 hour. The mixture was poured into a 250 mL autoclave and placed in the oven at different temperatures (from 120 to 180°C) for different periods of time (3, 8, and 12 hours). After cooling to room temperature each sample was filtered, washed with distilled water and dried by lyophilization.**

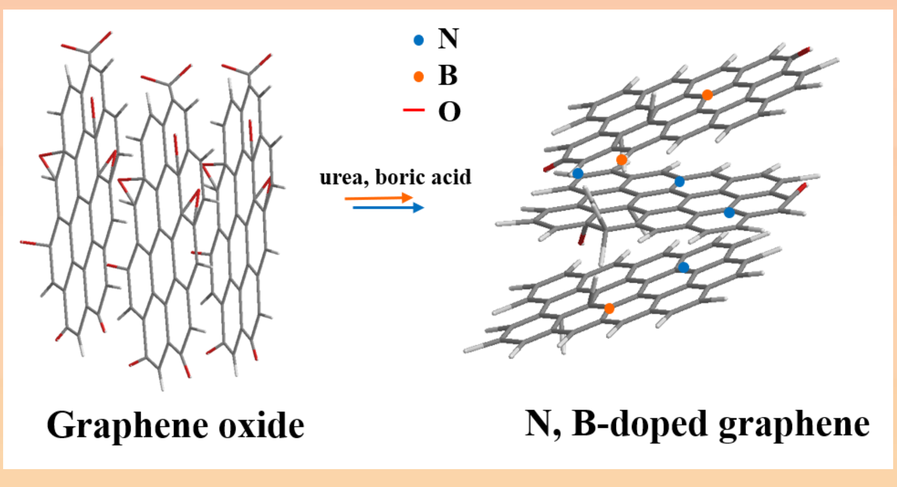
## Results and Discussions

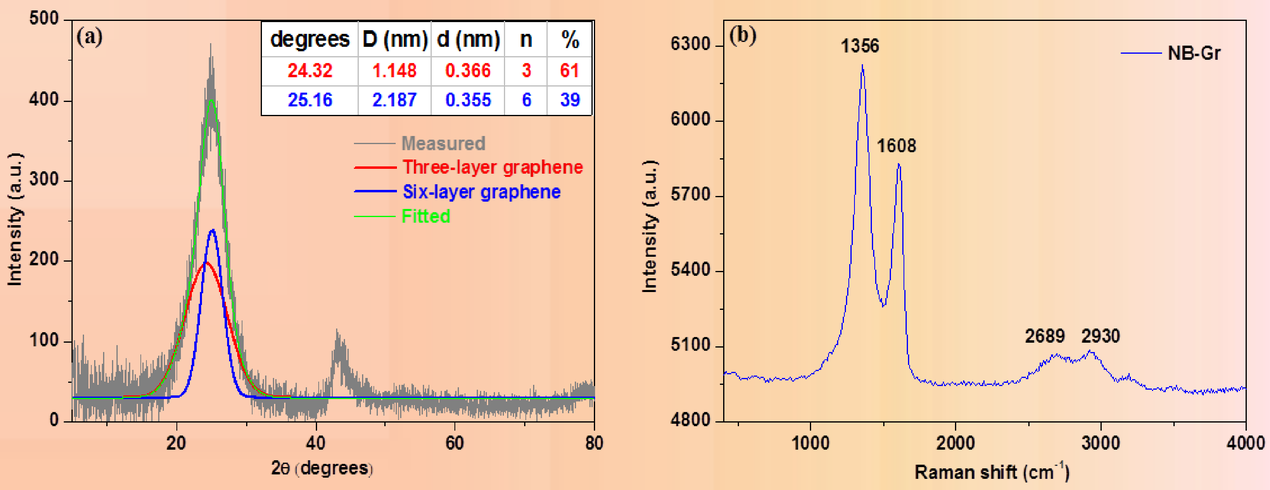
| Sample | Elemental composition (at%) | | | |
|---|---|---|---|---|
| | C | O | *N* | B |
| NBGr-120 | 47.9 | 38.6 | *10.8* | 2.6 |
| NBGr-160 | 64 | 24.2 | *9.3* | 2.4 |
| NBGr-180 | 76 | 10.3 | *11.8* | 1 |

**Chemical composition of NBGr samples according to XPS**

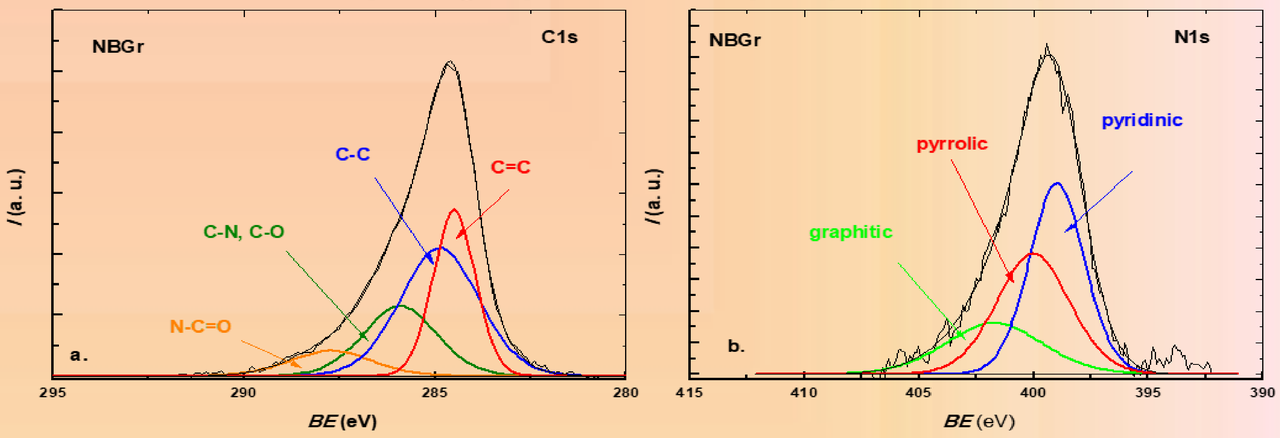


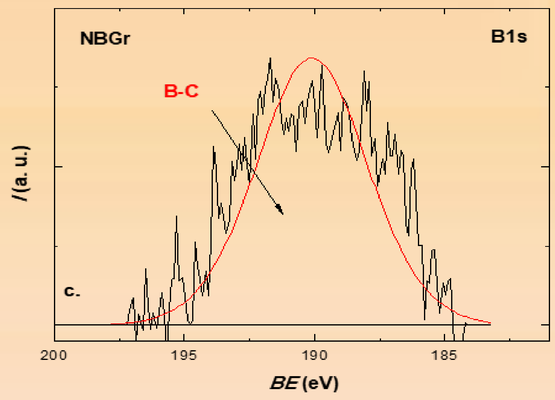

**SEM micrographs with different magnifications of N, B co-doped graphene sample (a) 2 μm; (b) 500 nm**




**The XRD pattern (a) and the Raman spectrum (b) of N, B co-doped graphene sample (NBGr-120)**




**High-resolution XPS spectra of C1s, N1s and B1s with the corresponding deconvolution components for the NBGr-120 sample**

## Conclusion

**In conclusion, the hydrothermal approach was employed to synthesize nitrogen, boron co-doped graphene samples (NBGr). The morphology and structure of the samples prepared at different temperatures, reaction time and doping reagents were characterized in detail. The best doping was obtained at 120°C in 12 hours.**

## Acknowledgements

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