激光氧化-调控氮化硼光学三阶非线性的新途径

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六方氮化硼 (h-BN) 是一种二维层状宽带隙绝缘材料，其结构与石墨烯类似，除了具有通常二维材料的特性，h-BN 还具有优异的力学、化学、热稳定性，因此在紫外激光器/探测器、近场光学/成像、保护层材料、介电层以及非线性光学领域等具有广泛的应用。

近日，澳大利亚斯威本科技大学埃米材料转化中心以及皇家墨尔本理工大学理学院的贾宝华教授课题组开发了一种可激光调控 h-BN 三阶光学非线性的方法。功能化是赋予材料新性质、通向新应用的重要途径。对 h-BN 材料进行原子级的化学键或官能团改造，是增强材料化学灵活性的有效途径。文中提出了对商业化购置的 h-BN 粉末利用一步式球磨法，在研磨过程中对 h-BN 的边缘修饰-NH_2 官能团，可以有效增强其可溶性。再利用真空抽滤法，对制备的 h-BN 溶液进行抽滤可以得到无衬底的 h-BN 薄膜。通过控制溶液的用量与浓度，h-BN 薄膜的厚度可精准控制在百纳米至微米量级。

贾宝华教授课题组利用 800 nm 的低重频飞秒激光聚焦后在 h-BN 薄膜上直写出了 50 μm×50 μm 的微型图案，开辟了 h-BN 材料超精细、低损伤、可设计加工任意形状的新方向。h-BN 作为新兴的光学材料，在近场光学成像、双曲透镜以及非线性光学器件等方面初见端倪。该文章提出了飞秒激光直写是在 h-BN 材料上实现高精度加工的有效途径，在此基础上，揭示了飞秒激光加工前/后材料化学特性以及光学性质的改变。

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Laser oxidation-a new approach to tuning the optical third-order nonlinearity of boron nitride

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Hexagonal boron nitride (h-BN) is a two-dimensional layered wide-bandgap insulating material. It has a wide range of applications in the field of nonlinear optics.

Recently, Prof. Baohua Jia's group from the Centre for Translational Atomaterials at Swinburne University of Technology, and the School of Science at RMIT University, has developed a method for laser-tunable third-order optical nonlinearity of h-BN. In this study, a one-step ball milling method for processing commercially purchased h-BN powders is proposed, and the edge modification of h-BN with -NH_2 functional groups during the grinding process can effectively enhance its solubility. The prepared h-BN solution can be filtered by vacuum filtration method to obtain a freestanding h-BN thin film. By controlling the amount and concentration of the solution, the thickness of the h-BN film can be precisely controlled in the order of hundreds of nanometers to micrometers.

Prof. Baohua Jia's group used 800 nm low-repetition-rate femtosecond laser to directly fabricate 50 μm × 50 μm micropatterns on the h-BN film, creating an ultra-fine low damage method to manufacture arbitrary h-BN structures.

It also proposes that femtosecond laser direct writing is an effective way to achieve high-precision processing on h-BN materials. On this basis, the changes in chemical properties and optical properties of materials before and after femtosecond laser processing are studied.

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