

Supporting information.

Effect of Amine Modified Boron Nitride (BN) on Ammonium Perchlorate Decomposition

Kevin D Grossman^a, Tamil S Sakthivel^a, Catherine Dillier^b, Eric L. Petersen^b, Sudipta Seal^{a*}

^aAdvanced Materials Processing and Analysis Center, Nanoscience Technology Center, Materials Science and Engineering, University of Central Florida, Orlando, FL 32816, USA. E-mail: Sudipta.Seal@ucf.edu

^bDepartment of Mechanical Engineering, Texas A&M University, College Station, Texas, USA

FTIR analysis was done on the products of hydrothermal reaction between boric acid and melamine as well as melamine, boric acid and commercially available BN. The product of the synthesis is most likely a multi-component material containing some h-BN, B₂O₃, B₄C and NH₂. This is supported by the TGA analysis of the synthesized material. The FTIR analysis shows the product to contain chemicals resembling the absorption of h-BN, B₂O₃ as well as the NH₂ groups found on melamine. Hexagonal BN is well studied and shows two distinct absorption peaks at 1370 cm⁻¹ and 700 cm⁻¹ which is also present in our material, although convoluted with absorption from other species'. Boric acid shows a large absorption peak around 1400 cm⁻¹ due to the vibration of a B-O bond, which is also seen in the synthesized material [1]. All other distinct peaks in boric acid spectrum are not present in the synthesized BN material. Theoretical and experimental data on the FTIR absorption was reported by Mircescu [cite] and showed melamine to have peaks at 569 cm⁻¹ from N-C-N bending as well as NH₂ twisting, 1022 cm⁻¹ and 1194 cm⁻¹, both from ring deformation as well as NH₂ vibration, 1434 cm⁻¹ and 1567 cm⁻¹, both from C-N stretching and NH₂ vibration, and peaks ranging from 3123 cm⁻¹ to 3468 cm⁻¹ due to N-H stretching [2]. The only peak reported to be solely due to absorption from NH₂ without any absorption from the heterocyclic ring structure of 1,3,5-Triazine is a peak

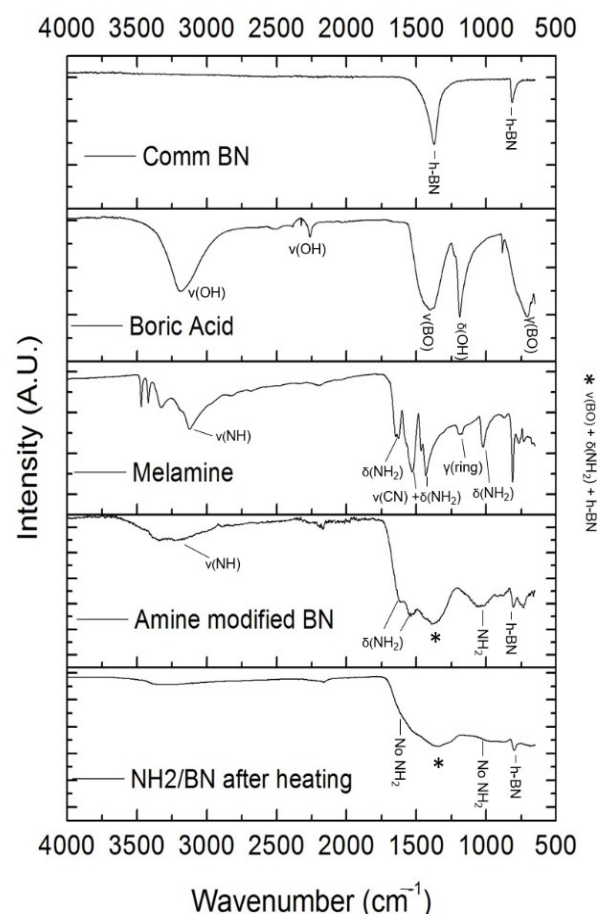


Figure S1: FTIR spectra of reactants and product of hydrothermal synthesis process, commercially obtained BN and amine modified BN after reaction with AP

found at 1646 cm^{-1} , which is present in our material. This peak is missing from the FTIR spectrum of the material that was heated to 800°C , which supports the proposed mechanism that the NH_2 in the material is responsible for the accelerated decomposition of AP. The material heated to 800°C was added to AP at 1 wt% and showed no effect on the thermal decomposition profile.

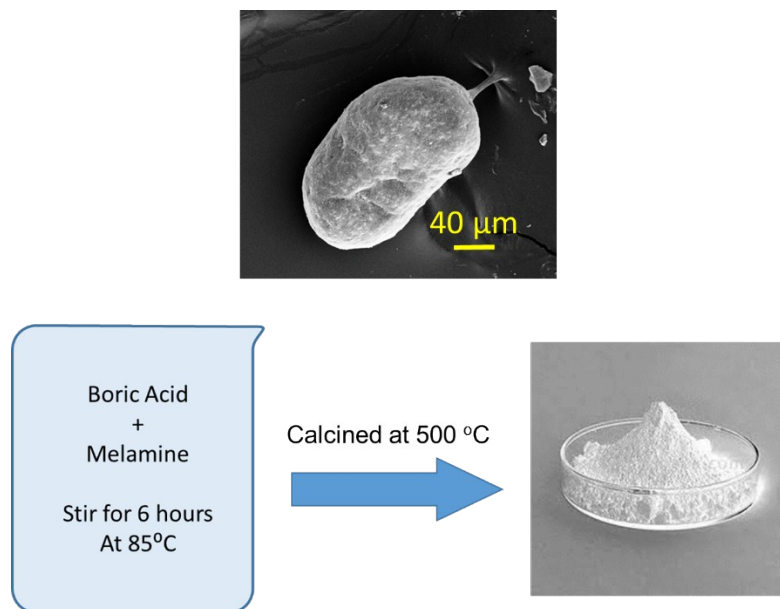


Figure S2: AP crystal roughly $200\mu\text{m}$ in size. Synthesis process for amine modified BN using melamine and boric acid as precursors. This process was chosen for its simple, low cost processability.

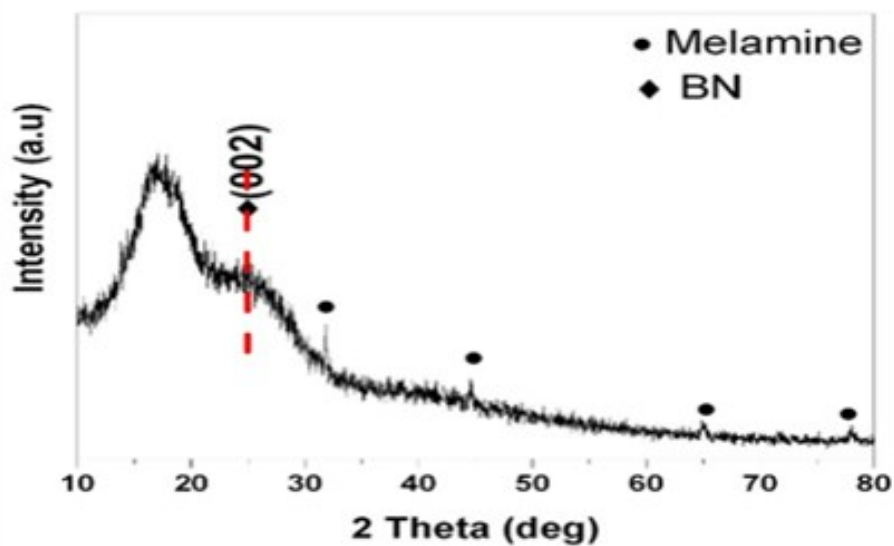


Figure S3: XRD graph of synthesized BN. The material is largely amorphous with only slight peaks from the melamine components that attach to the BN ribbons.

References

- [1] Mircescu, N. E., Oltean, M., Chiş, V., & Leopold, N. (2012). FTIR, FT-Raman, SERS and DFT study on melamine. *Vibrational Spectroscopy*, 62, 165-171. doi:10.1016/j.vibspec.2012.04.008
- [2] Harabor, A., Rotaru, P., Scorei, R., & Harabor, N. (2014). Non-conventional hexagonal structure for boric acid. *Journal Of Thermal Analysis & Calorimetry*, 118(2), 1375-1384. doi:10.1007/s10973-014-4169-5