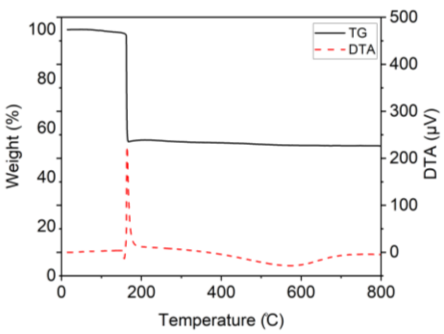
Temperature-Dependent Carbonization of Pyridine-Stabilized Alkynylborane for Energy Storage Applications

([1]*Graduate School of Environment, Life, Natural Science and Technology, Okayama University*) ○Kentaro Ohkura,[1] Yuta Nishina[1]

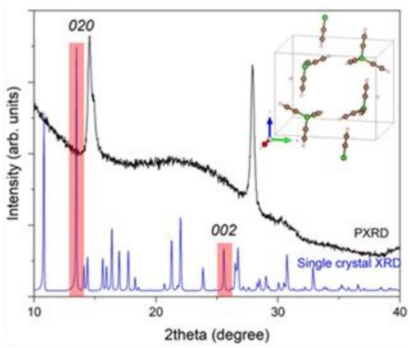
Keywords: *Carbon material, Lewis acid, Porous material, Boron-doped carbon*

Boron-doped carbon (BDC) has attracted attention as an alkali-ion storage anode material.[1] Previous studies have reported the synthesis of BDC materials using boric acid or boron oxide as starting materials.[2] However, these molecules require significant energy to cleave the B-O bonds and form the B-C bonds, making it challenging to control the bonding states of boron. Ethynyl groups are known as functional groups that promote carbonization through pyrolysis. Additionally, three-dimensional carbons are synthesized from ethynyl-containing organic compounds.[3] In this study, we designed ethynyl-containing boron molecules to serve as building blocks for BDC.

We focused on triethynylborane (**TEB**) as an ethynyl-containing boron molecule. Three-coordinated boron compounds like **TEB** are sensitive to oxygen because of their high Lewis-acidity. In this study, we synthesized TEB-pyridine complex (**TEB-Py**), which is stabilized by coordinating Lewis base to the boron center. We investigated the thermal behavior of **TEB-Py** by TG-DTA (Figure 1). As a result, we confirmed endothermic and exothermic peaks at 157 and 160 °C, respectively. The first peak (157 °C) evidences the desorption of pyridine, and the second one (160 °C) indicates the polymerization of ethynyl groups. Based on the TGA study, we synthesized BDC at three different temperatures (200, 600, and 900 °C) and named them **TEB-C$_X$**, where x denotes temperature. We compared the experimental XRD pattern of **TEB-C$_{200}$** with the simulated XRD pattern of **TEB** (Figure 2), which evidenced that carbonization proceeded by desorption of pyridine. Obtained BDCs were evaluated for their potential applications in lithium and sodium ion storage.



(Figure 1) TG-DTA analysis of **TEB-Py**



(Figure 2) Simulated XRD pattern of **TEB** and measured XRD pattern of **TEB-C$_{200}$**.

1) C. Ling, *et al.*, *Phys. Chem. Lett.*, **2013**, *4*, 1737.; 2) Y. A. Kim, *et al.*, *ACS Nano*, **2012**, *6*, 6293.; 3) T. Ogoshi, Y. Nishina, *et al.*, *Commun Chem.*, **2021**, *4*, 75