BH and BD molecular spectroscopy during the Impurity Powder Dropper experiments

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Boronization is one of popular tools for wall conditioning in magnetically confined fusion devices. Aiming for real-time boronization during plasma discharges, experiments of boron powder injection are performed by using the Impurity Powder Dropper (IPD) system [1] in the Large Helical Device (LHD). To obtain information on transport of injected boron and on interaction between plasmas and boron, we investigate boron hydride (BH) and boron deuteride (BD) molecular spectra observed during IPD experiments. Since the dissociation energy of BH and BD molecules are as low as 3.5 eV, spectroscopic measurements of BH/BD bands can be good diagnostics for interaction between boron and hydrogen near plasma-facing walls.

We performed spectroscopic observation by using a visible spectrometer [2] whose focal length of 1.33 m. The spectrometer has a spatial resolution of 26 mm, and 44 lines of sight are across a poloidal cross-section. The dispersion of the spectrometer is 0.35nm/mm, and we confirmed BH/BD molecular bands around 433 nm during IPD experiments. H-gamma and D-gamma lines locate at 434 nm. Thus, we can resolve BH/BD molecular bands and H-gamma/D-gamma lines, and can observe them at the same time in a same wavelength window.

During the experiments, two or three sources of BH/BD emission are confirmed around diverter leg. The number and positions of sources depend on the radius of the magnetic axis R_{ax} and on the amount of injected boron. Considered that distribution of diverter plasmas changes as R_{ax} changes, the observed result suggests that plasmas outside the last closed flux surface can affect the formation of BH/BD molecules.

[1] A. Nagy, et al., Rev. Sci. Inst. 89, 10, id.10K121 (2018)
[2] M. Goto, et al., Fusion Science and Technology, 58, 1, 394-411 (2010)