9th International Workshop on 2D Materials

Title of the Presentation: Bilayer graphene: CVD growth, machine learning-based analysis, and intercalation

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Short Biography:

Hiroki Ago received his PhD from Kyoto University in 1997. After staying at Cavendish Laboratory, Cambridge University during 1997-1999, he moved to National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba as a researcher. In 2003, he moved to Kyushu University and now is a distinguished professor of Kyushu University. His current research focuses on science and applications of nanomaterials, particularly graphene and related 2D materials. He received Iijima Award from the Fullerene-Nanotube Research Society of Japan (2006), Young Scientist Award from the MEXT, Japan (2008), and Best Paper Award from the Japan Society of Applied Physics (2014). Now he is a leader of the new MEXT project "Science of 2.5 Dimensional Materials".

Abstract:

Bilayer graphene (BLG) has attracted increased interest, because of their unique physical properties, such as band gap opening observed in AB-stacked bilayer, and superconductivity found in magic-angle twisted bilayer. In this presentation, the CVD growth of uniform BLG and perfectly AB-stacked BLG are presented with the aid of epitaxial Cu-Ni(111) thin films on c-plane sapphire [1,2]. We developed a new method to determine the twist angle of the CVD-grown BLG by machine learning based on the Raman spectra of BLG [3]. Furthermore, CVD-grown BLG was used to intercalate various metal chlorides molecules [4-6]. In particular, $AlCl_3$ molecules exhibited unique 2D super-structures, which are completely different from the bulk crystal (Fig. 1) [5]. Our work opens a new possibility of making new structures and new materials in the 2D nanospace realized in BLG. I will also introduce our recent work on large-area graphene/hBN heterostructures all made by CVD.

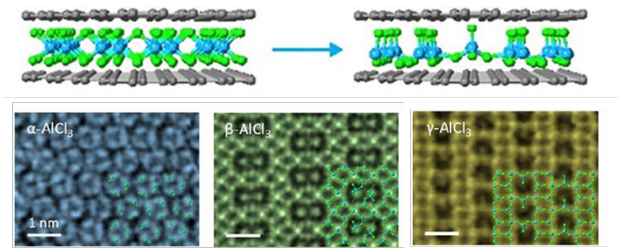

Fig. 1. Intercalation in the interlayer nanospace of BLG. Three new 2D crystal structures of $AlCl_3$ molecules were first discovered in the interlayer nanospace.

[1] Y. Takesaki et al., *Chem. Mater.*, **28**, 4583 (2016).
[2] P. Solis-Fernandez et al., *ACS Nano*, **14**, 6834 (2020).
[3] P. Solis-Fernandez and H. Ago, *ACS Appl. Nano Mater.*, **5**, 1356 (2022).
[4] H. Kinoshita et al., *Adv. Mater.*, **29**, 1702141 (2017).
[5] Y.-C. Lin et al., *Adv. Mater.*, **33**, 2105898 (2021).
[6] Y.-C. Lin et al., *Nano Lett.*, **21**, 10386 (2021).