Towards the graphene formation at 150°C

Nagoya Inst. of Tech.[1], Univ. Pend. Sultan Idris[2]

Mona Ibrahim Araby[1], Subash Sharma[1], Mohamad Saufi Rosmi[2], Golap Kalita[1] and Masaki Tanemura[1]

E-mail: monaaraby4@gmail.com

Graphene, 2-dimensional carbon nanomaterial, is promising for various applications of next generation semi-conductor and energy storage devices [1]. Generally graphene synthesized at high temperatures from gas phase. However, for the future device applications, especially for transparent and flexible devices graphene should be synthesized at lower temperatures. Here we demonstrate a simple method to synthesize graphene at 150°C using In , which has been rarely used as a catalyst for the chemical vapor deposition (CVD) synthesis of graphene.

Prior to the graphene growth on a flat substrate, the catalytic activity of the novel catalyst, In, for the graphene growth was examined. For this purpose, In-included carbon nanofibers (In-CNFs) were prepared for the transmission electron microscope (TEM) observation of their graphitization in solid (liquid) phase reaction. Samples employed were polycrystalline carbon foils of 0.5 cm x 2.5 cm in size. The carbon foil and an In plate, which was placed perpendicularly to the carbon foil as a metal supply source, were sputtered with Ar^+, using a Kaufman type ion gun (Ion Tech. 3-1500-100FC). After sputtering, the topography of the sample surfaces and the crystalline structure of In-CNFs thus grown were carefully observed by scanning electron microscopy [SEM (JEOL; JEM-5600)] and by TEM (JEOL JEM- 2010HR), respectively.

Surprisingly, the conical tips featured few layer graphene for as-prepared In-CNFs, suggesting that In should possess a great potential for the low temperature synthesis of graphene. Encouraged by this finding, we attempted heating of In and carbon stacked films on a SiO_2 substrate at 150°C in a vacuum ambient. The multilayer graphene formation was confirmed on the agglomerated In flakes by Raman spectroscopy after heating. Thus, it is believed this finding will open up the synthesis of graphene at further lower temperatures [2, 3].

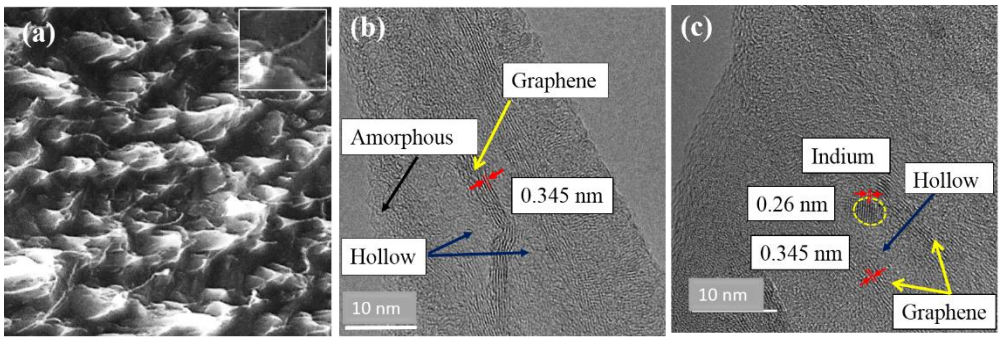

Fig.1. (a) SEM images of In-CNF tipped cones. (b) and (c) High magnification TEM images, showing the graphene formation in the vicinity of hollow region and an In nanoparticle (encircled) located in the vicinity of hollow region, respectively.

References:

[1] A. K. Geim and K. S. Novoselov, Nat. Mater., 6, 183 – 191(2007).

[2] I. A. Mona, M. Tanemura, et al., RSC Advances, 7, 47353 – 47356 (2017).

[3] R. Vishwakarma, M. Tanemura, et al., Scientific Reports, 7, 43756 (2017).