

Diameter controlled CVD growth of nitrogen-incorporated single-walled carbon nanotubes

Shigeo Maruyama¹, Theerapol Thurakitseree², Christian Kramberger³, Kazuki Ogasawara¹, Shohei Chiashi¹, Erik Einarsson⁴

¹*Department of Mechanical Engineering, The University of Tokyo*

²*Department of Physics, Maejo University*

³*Faculty of Physics, University of Vienna*

⁴*Department of Electrical Engineering, University at Buffalo, State University of New York*

As we synthesized single-walled carbon nanotubes (SWNTs) using acetonitrile (AcN)-mixed ethanol (EtOH) feedstock, the SWNT mean diameter was dramatically reduced as AcN was added [1, 2]. Surprisingly, the main nitrogen configuration was found to be encapsulated diatomic N₂ molecules in the interior of SWNTs with the content of 1 at % [3]. As the sequence of feedstock was switched during synthesis, SWNT diameter was changed along the vertically aligned array. We have revealed continuous junctions by high-resolution transmission electron microscopy [4]. This diameter modulation was reversible upon the sequence of feedstock introduction. By using ¹⁵N isotope of acetonitrile, the catalytic decomposition of acetonitrile in the initial reaction step was studied [5]. The initial decomposition process of acetonitrile on metal clusters is directly measured by using FT-ICR (Fourier Transform Ion Cyclotron Resonance) mass spectrometer.

[1] T. Thurakitseree et al., Carbon 50 (2012) 2635.

[2] T. Thurakitseree et al., pssb 249 (2012) 2404.

[3] C. Kramberger et al., Carbon, 55 (2013) 196.

[4] T. Thurakitseree et al., ACS Nano 7 (2013) 2205.

[5] C. Kramberger et al., Nanoscale (2014).