FT-IR Gas Analysis for Alcohol Catalytic Chemical Vapor Deposition

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Abstract
   Alcohol catalytic chemical vapor deposition (ACCVD) has become a popular CVD method for growth of high-purity single walled carbon nanotube (SWNT) films due to the low cost and easy-handling of a non-hazardous CVD gas source. [1] At CVD temperatures, ethanol mainly decomposes into ethylene and water. [2] These thermally generated molecules could affect SWNT growth. However, there are few gas analysis studies for ACCVD.

   In this study, we have investigated gas molecules behavior during ACCVD using Fourier Transfer infrared spectroscopy (FT-IR: Otsuka electronics IG-1000). FT-IR cell was inserted between a reactor tube and a vacuum pump. SWNT synthesis was performed by using ethanol as the carbon source and Co/Mo bimetal as the catalyst.   Growth temperature was 1113 K.
   The time dependence of gas molecule intensities is shown in Fig.1. In order to distinguish catalytic decomposed molecule intensities from thermally decomposed molecule intensities, the intensities obtained in the presence of catalyst were subtracted from those obtained in the absence of catalyst. In the early stage, ethanol was consumed and ethylene and water were generated. After a few minute, ethanol was reached to zero, and ethylene and water were changed from generation mode to consumption mode. The consumption mode was continued during growth period. This mode would be caused by deposition and etching of carbon on the substrate and/or synthesized SWNT surface.
   We will discuss this behavior of gas molecules with time dependence of SWNT film thickness and weight.
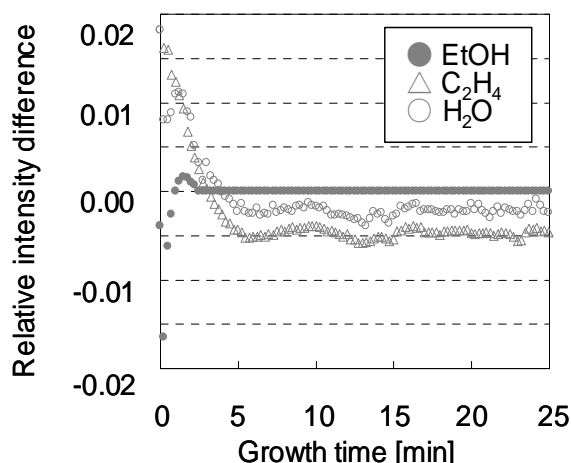

Fig.1 FT-IR intensity difference of with and without catalysts for ethanol, ethylene, and water as function of growth time.   Each intensity is normalized by the intensity of

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