Chemical solution processed MoS_2 on high-k oxide film

(D)Joonam Kim[1] , Kenichi Haga[1], Koichi Higashimine[2] and Eisuke Tokumitsu[1]

[1]School of material science, Japan Advanced Institute of Science and Technology (JAIST)

[2]Nano material technology center, Japan Advanced Institute of Science and Technology (JAIST)

1-1 Asahidai, Nomi, Ishikawa, 923-1292, Japan

E-mail: joonam_k@jaist.ac.jp

Two dimensional dichalcogenide is a family of semiconductors, which exhibits both n-type and p-type conductivity with relatively high carrier mobility. In particular, the material group has an energy band gap, which leads to large on/off ratio when it is applied to thin film transistors (TFTs). Recently, exfoliated MoS_2 atomic thin layers have been fabricated into transistors which demonstrate excellent on/off current ratios and high carrier mobility. On the other hand, for large area formation of MoS_2 at low cost, the solution based process is promising. In this work, we report chemical solution process for MoS_2 on high-k dielectric films.

The SiO_2 is usually used as substrate for other deposition techniques such as chemical vapor deposition because it has low roughness, thermal stability. However, the deposited film should be transferred to other film because of low dielectric constant of SiO_2. During the transferring process, there are definitely the damages such as disassemble, film break of the MoS_2 film and undesirable strain. To obtain better performance for TFTs, it is preferable to deposit MoS_2 on the high-*k* thin film, directly.

Source solution used in this work is ammonium tetrathiomolybdate ($(NH_4)_2MoS_4$) dissolved in N-Methyl-2-pyrrolidone (NMP). Figure 1 shows the Raman spectrum of chemical-solution-processed MoS_2 directly deposited on Nb doped ZrO_2 (NZO) film. Annealing at 450 ºC in H_2/Ar (5:95) atmosphere (first step) no peak is found, whereas after 990 ºC annealing with sulfur vapor (second step) clear peaks at 385 cm^{-1}(E_{2g}) and 410 cm^{-1}(A_{1g}) are observed. We also confirmed the formation of MoS_2 layers by transmission electron microscope (TEM). The details will be presented at the conference, including coating properties on various oxide substrates, which correlates surface energies of the substrates.

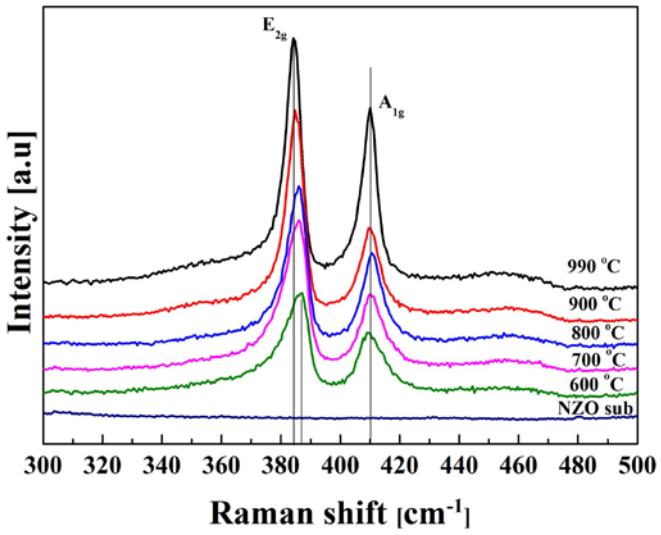

Figure 1. Raman spectra of MoS_2 on NZO with variation annealing temperature.

© 2016年 応用物理学会