Contribution ID: **49** Type: **Invited Talk**

Transition metal dichalcogenide nanotubes

Wednesday, 11 July 2018 09:00 (30 minutes)

Due to their favorable and rich electronic and optical properties, group-VI-B transition-metal dichalcogenides (TMDs) have attracted considerable interest. They have earned their position in the materials portfolio of the spintronics and valleytronics communities. The electrical performance of TMDs will be enhanced by rolling up the two-dimensional (2D) sheets to form quasi-one-dimensional (1D) tubular structures. Actually, the TMD nanotubes were first synthesized back in 1992 [1], but only recently device related researches have been conducted [2].In this presentation, we discuss transport and optoelectronic properties ranging from field effect transistor (FET) operation to solar cell actions in tungsten disulfide multiwalled nanotubes (WS2-NT).
We first fabricated electric double layer transistor (EDLT) of an individual WS2-NT and found an ambipolar operation, in sharp contrast to the solid gated FET devices which exhibits only n-type conduction. Furthermore, we found that gating with KClO4/polyethylene glycol electrolyte, induce superconductivity at Tc = 5.8 K. This is the first superconductivity in the individual nanotube structure. Importantly, this superconductivity of gated WS2 exhibited peculiar transport properties arising only from tublar and chiral structure [3].
Using the EDLT devices, we were able to fabricate a p-n junction in an individual WS2-NT, and found that this p-n junction shows current-driven light emission, and photovoltaic actions. Both of these actions are linearly polarized along the NT axis, and more importantly, the external quantum efficiency for the photovoltaic effect reaches a value as high as 4.8%, exceeding by far that of 2D TMDs and even approaching the internal quantum efficiency of the 2D TMDs [4].

[1] R. Tenne et al., Nature 360, 444 (1992).
[2] R. Levi et al., Nano Lett. 13, 3736 (2013).
[3] F. Qin et al., Nat. Comm. 8, 14465 (2017).
[4] Y. J. Zhang et al., 2D Materials, in press.

Summary

Primary author: IWASA, Yoshi (The University of Tokyo & RIKEN)

Presenter: IWASA, Yoshi (The University of Tokyo & RIKEN)