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Title of the Presentation: Research on Schottky Contact of Monolayer WS_2 in Transparent Solar Cell

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Short Biography:

Xing He is a Ph.D candidate under the supervisor of Dr. Kato and Prof. Kaneko at Tohoku University. Her current research interests focus on fabrication of highly transparent solar cell with TMD in large scale. She won a scholarship from the China Scholarship Council (CSC).

Abstract:

TMD is one of the most attractive materials for future transparent and flexible optoelectrical devices due to their atomically thin structure, band gap in visible light range, and high optical transparency. Those merits of TMD have not been applied for transparent and flexible solar cell, which is attracted intense attention as a next-generation energy harvesting technology. Recently, we have developed a new fabrication process of TMD-based solar cell [1]. In our process, Schottky type device configuration is utilized, which can be simply formed by asymmetrically contacting electrodes and TMD (Fig. 1). The power conversion efficiency (PCE) can be reached up to 0.7 %, which is the highest value for solar cell with similar TMD thickness [1].

In order to achieve higher efficiency, it is important to investigate the detailed contact between TMD and electrodes. Thin metal (M_x) deposited ITO and pure ITO were used as Schottky and Ohmic electrode, respectively. Monolayer WS_2 was used as a suspended channel between each electrode. Schottky barrier height (SBH) was measured by photocurrent line scan through the channel under different bias conditions for various devices.

The SBH of M_x = Au, Ag, Cu increase with WF of M_x/ITO, which can be explained with traditional band model. Although higher SBH can be expected with Ni by following this trend, the SBH of Ni was lower than that of Cu. This can be explained by difference of Fermi level pinning effect. The Fermi level pinning factor (S), i.e. weakness of Fermi level pining effect, is known to be sensitive to the binding energy between metal and channel material. Ni is known to have higher binding energy than that of other metals such as Au, Ag, and Cu. Thus, Ni should show smaller S and lower SBH than other metals, which is consistent with our results. Based on these investigations, we successfully revealed the most suitable M_x (Cu) for Schottky electrode in TMD-based solar cell, which has relatively higher WF and weaker pinning effect, resulting in higher SBH and PCE. This finding is essential for understanding the contact between TMD and electrodes, and further improvement of the device performance can be expected.

[1] T. Akama, W. Okita, R. Nagai, C. Li, T. Kaneko, and T. Kato, Sci. Rep. **7**, 11967 (2017).

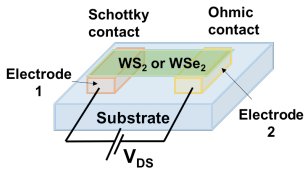

Fig.1. Typical device structure used in this study.