

Growth Behavior of Ni on Hydrogen-Cracked WS₂ Surface

Hui-Ting Liu (劉卉庭)^{1,2}, Wan-Hsin Chen (陳琬忻)², Shu-Jui Chang (張書睿)³, Chueh-Cheng Yang (楊爵丞)⁴, Chia-Hsin Wang (王嘉興)⁴, Wei-Tung Liu (劉緯彤)², Kuan-Yu Chen (陳冠羽)², Naoya Kawakami (川上直也)², Chun-Liang Lin (林俊良)², and Chenming Hu (胡正明)^{1,5}

¹International College of Semiconductor Technology, Hsinchu, Taiwan

²Department of Electrophysics, National Yang Ming Chiao Tung University, Hsinchu, Taiwan

³CREDM Taiwan Semiconductor Manufacturing Company, Hsinchu, Taiwan

⁴National Synchrotron Radiation Research Center, Hsinchu, Taiwan

⁵Department of Electrical Engineering and Computer Sciences, University of California, Berkeley, California, USA

htliu006@gmail.com

Abstract

Transition metal dichalcogenides (TMDs) consist of two-dimensional layers held together by van der Waals forces, with diverse and unique characteristics that make them promising materials for future electronic devices. However, forming good contact between the TMDs and metal is still challenging: when a thin metal film is deposited on the TMD surface, poor adhesion causes uneven coatings or delamination of the film. Our research aims to establish a technique that ensures the proper adhesion between the thin film and the TMD surface.

In this study, we investigated the effect of surface defects in growing metal thin films, using Ni/WS₂ as a model case. Exposure of WS₂ to the atomic H gas *in situ* effectively removes the surface sulfur atoms. The following growth of Ni thin films was characterized by scanning tunneling microscopy (STM) and synchrotron-based X-ray photoemission (XPS).

The defects in the WS₂ notably change the nickel growth behavior: while aggregated clusters were formed on the intrinsic surface, dispersed nuclei were observed on the defective surface. In addition, the bonding analysis revealed significant hybridization between Ni and S, as well as charge transfer between Ni and W. We found that the growth of thin film on TMD is controllable through surface treatment, which should provide valuable insights for developing enhanced materials and interfaces for advanced applications.

Keywords - 2D material, WS₂, XPS