Production of well-defined surfaces for catalysis

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Catalysis, a surface-sensitive phenomenon, undoubtedly depends on the availability of active surfaces. One has to prepare well-defined surfaces and check the surface-specific activity to understand the mechanism behind catalysis. Transition metal-doped ZnO materials are an example class of an electrocatalyst useful for electro-organic synthesis. The ZnO crystal exhibits different polarity and surface stability in different crystallographic directions [1]. To understand the mechanism of heterogeneous catalysis, it is necessary to understand on or from which surface the electrolyte is mainly adsorbed or desorbed [2]. With this aim of producing well-defined surfaces, we utilized the advancements of thin film technology.

Pulsed laser deposition (PLD) and molecular beam epitaxy (MBE) are state-of-the-art methods for fabricating epitaxial thin films. However, phase-separated material growth is probable when depositing transition metal doped ZnO. We modified a PLD system by attaching molecular beam sources to prepare such surfaces with precise fine-doped elements and stoichiometry control.

This work will present the challenges and importance of growing well-defined catalyst surfaces, especially transition metal-doped ZnO. We will address previously reported works and our ongoing studies on the thin film deposition of transition metal-doped ZnO thin films by means of a hybrid PLD-MBE setup.

[1] C.-H.P. Sung-Ho Na, First-Principles Study of the Surface of Wurtzite ZnO and ZnS - Implications for Nanostructure Formation, *The Journal of the Korean Physical Society*, 54 (2009) 5, doi: 10.3938/jkps.54.867

[2] S. Akhter, K. Lui, H.H. Kung, Comparison of the chemical properties of the zinc-polar, the oxygen-polar, and the nonpolar surfaces of zinc oxide, *The Journal of Physical Chemistry,* 89 (1985) 1958-1964, doi: 10.1021/j100256a029