

# Surface defects engineering and reactivity towards methanol decomposition of pristine and defected PtTe<sub>2</sub>

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## Abstract

Layered transition metal dichalcogenides (TMDs) have attracted considerable interest because of their peculiar electronic properties and potential application in varied fields. However, their catalytic properties are still unknown. Herein, we demonstrate the PtTe<sub>2</sub> surface structure and chemical state dramatically changed by means of the Argon-ion bombardment treatment and which is attributed to the creation of the surface Te-defects after the Ar-sputtering. Meanwhile, the chemical activity is triggered from the chemical inert basal plane to the active surface toward the methanol decomposition reaction. The reflection high energy electron diffraction (RHEED) is utilized to identify the surface crystal structure of the PtTe<sub>2</sub>. The vague deflection lines in the RHEED patterns from crystalline PtTe<sub>2</sub> after the Ar-sputtering represent the significant morphology changing with the formation of the Te-defects. The photoelectron spectroscopy (PES) is utilized to probe the surface chemical state and the chemical activity. We found an increasing low-binding energy shoulder emerge on the Pt-4f electronic state after the Ar-sputtering, which is attributed to the formation of Pt dangling bonds at the Te-defects sites. Namely, to some degree, the signal ratio between the Pt-4f peak and low-binding energy shoulder (Pt\*/Pt) represents the surface Te-defects concentration. Furthermore, the surface chemical activity toward the methanol decomposition of PtTe<sub>2</sub> is also changed after the Ar-sputtering, i.e. the existence of the surface Te-defects.