Contribution ID: **69** Type: **Poster Only**

ToF-SIMS Analysis of Coke-Resistant Two-Dimensional Metal Carbide Catalysts

Catalysts can be described by three important aspects: activity, selectivity, and stability. Activity is the ability of a catalyst to convert reactants into products. Selectivity is the ratio of the desired product to the total amount of converted molecules. Stability is the ability of a catalyst to maintain activity with respect to time on stream (TOS, time since initial contact of reactant gas to the catalyst bed) in continuous reactors. MXene, a class of two-dimensional metal carbides, can be used as a support material to create a coke-resistant nanolayer catalyst with excellent activity, selectivity, and stability. In our prior studies, platinum (Pt) was loaded onto Mo2TiC2 MXene using incipient wetness impregnation to synthesize a 0.5% (wt.) Pt/Mo2TiC2 Pt nanolayer MXene catalyst. The Pt nanolayer catalyst exhibited excellent activity with turnover frequencies (TOFs, converted molecules per surface Pt atom) of 0.4~1.2 s-1 for converting methane and ethane. 0.5% Pt/Mo2TiC2 displayed high selectivity, over 98% to C2 products for non-oxidative coupling of methane(NOCM) and over 95% selectivity for catalytic dehydrogenation of ethane to ethylene. Stability is obtained with no loss in catalytic activity for 72 hr. and 24 hr. TOS for NOCM and ethane dehydrogenation, respectively, owing to strong coke-resistance. Time-of-flight secondary ion mass spectrometry (ToF-SIMS) is a highly sensitive surface analysis technique capable of molecular, atomic, and isotopic analysis. Coupling ToF-SIMS with sputtering allows for analysis of subsequent monolayers of a sample's surface. Measurements, including surface spectra, mass spectral imaging, secondary electron imaging, and depth profiling, were used to probe the surface and bulk structures of both unloaded Mo2TiC2 MXene support and 0.5% Pt/Mo2TiC2 nanolayer MXene catalysts. The large dispersion of Pt+ ions throughout the bulk of Pt/Mo2TiC2 nanolayer MXene supports the hypothesis that the MXene channel prohibits access to the terrace site, a critical site for the structure-sensitive coking reaction

Topical Area

Hard matter: energy materials

Author: MISICKO, Tobias (Oak Ridge National Laboratory and Louisiana Tech University)

Co-authors: PARKER, Gabriel (Oak Ridge National Laboratory); YU, Xiao-Ying (ORNL); Dr XIAO, Yang (Louisiana Tech University)

Presenter: MISICKO, Tobias (Oak Ridge National Laboratory and Louisiana Tech University)