



Contribution ID: 172

Type: **Poster**

Investigating the interaction of water with vanadium oxide surfaces by XPS

Monday, 17 September 2018 17:45 (15 minutes)

The adsorption of molecules on vanadium oxide surfaces has been studied extensively, due to their widespread use in industrial catalysis. X-ray photoelectron spectroscopy (XPS) provides detailed information on the chemical bonding states of adsorbed molecules, and how they influence surface properties. However, previously existing XPS studies of molecules on vanadium oxide surfaces were limited to those performed in high vacuum, and thus may not represent the conditions present in industrial reactions. Here, we bridge this “pressure gap” with “ambient pressure” XPS, where we have used synchrotron and lab X-ray sources to study vanadium oxide surfaces in the presence of water at pressures up to 2 Torr. These measurements provide insights on how moisture affects the surfaces of various oxidation states (V^{3+} , V^{4+} and V^{5+}) at catalytically relevant temperatures up to 400 °C. We also explore the behaviour of the system across the metal-insulator transition in VO_2 .

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Session Classification: Poster session 1

Track Classification: P8 Functional materials and materials science