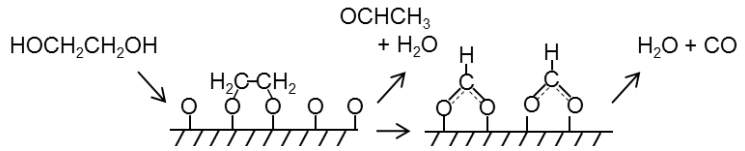
Multifunctional Organic Molecules React Differently On A Well-Characterized Oxide Surface

The reactions of complex, poly-oxygenated organic molecules on a catalytic substrate are very different from their simpler, mono-oxygenated analogs. Raw biomass material is converted by pyrolysis into bio-oils which are a complex mixture of alcohols, aldehydes and organic acids. The bio-oils must be upgraded by removing the oxygen and coupling carbon chains into larger organic molecules to produce useful fuels and chemicals. We have conducted the first study of a poly-oxygenated molecule on a well-characterized, single crystal metal oxide surface.

Cerium oxide (CeO_2) is an important catalytic material because the oxygen in the substrate can directly participate in the catalytic reaction. This can promote the addition or removal of oxygen from the reactants.

Ethylene glycol interacts with a ceria surface through both of its alcohol groups (Scheme 1). This leads to very different chemistry compared to the analogous mono-alcohol, ethanol. Ethylene glycol primarily decomposes to water and CO, which is an undesired reaction, whereas the C-C bond remains intact in ethanol so that acetaldehyde and ethylene are the reaction products. *It is therefore critical to develop a fundamental understanding of the reactions of more realistic, complex organic molecules to better utilize biomass feedstocks for energy production.*



Scheme 1 – Adsorption and reaction of ethylene glycol on CeO_2(111).

Tsung-Liang Chen and David R. Mullins, "Ethylene Glycol Adsorption and Reaction over CeO_X Thin Films", *J. Phys. Chem. C.* **2011**, 115, 13725 - 13733