The Surface Chemistry of Cobalt Sulfide in Thermo-Catalytic Oxygen Transfer Reactivity

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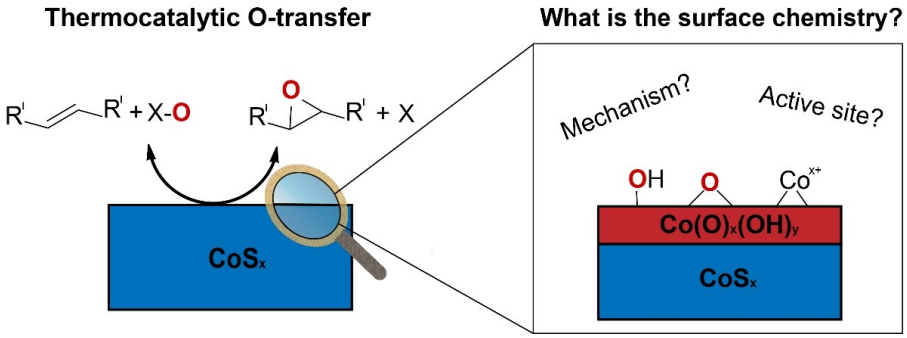
New advances in heterogeneous catalysis have often been achieved by applying known principles from related fields of molecular or enzymatic catalysis.[1] Here we get inspired by well-known principles from electrocatalysis of earth-abundant materials for the discovery of new thermo-catalytic reactions by these materials. Specifically, cobalt sulfide materials (CoS_x) have shown high activity for the electro-catalytic oxygen evolution reaction (OER)[2-3], and we hypothesized that these materials might also be active catalysts for thermal oxygen transfers.

We show that CoS_x can indeed catalyze thermal epoxidations and epoxide deoxygenations and outperform as-synthesized cobalt -oxide, -hydroxide, and -oxyhydroxide. This is curious as the CoS_x oxidize during epoxidation reactions, similarly to OER where the sulfides oxidize under the highly oxidative conditions.[2-4] Under the milder epoxide deoxygenations conditions, on the other hand, bare CoS_x remains exposed, suggesting an intrinsic oxygen transfer activity of the sulfides. In this poster we discuss parallels between the electro- and thermo-catalytic oxygen transfers by CoS_x in terms of surface chemistry, active species, and mechanism based on preliminary spectroscopic and mechanistic investigations. This work provides new insight into more insight into key structure-reactivity relationships on CoS_x surfaces and shows the utility of taking inspiration from different fields to make new discoveries in catalysis.



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