

CO₂ capture on iron oxide surfaces: Tuning redox behavior in favor of host-guest-type interactions

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Control and reduction of global warming induced by so-called greenhouse gases like carbon dioxide (CO₂) represents one of the biggest and most urgent challenges for mankind to date. However, CO₂ removal from the atmosphere is technologically difficult.

Motivated by that, we study CO₂ adsorption on the magnetite Fe₃O₄(111) surface. CO₂ is known to be a strong electron acceptor and forms stable adspecies (carbonate, carboxylate) on various metal oxide surfaces, as demonstrated, e.g., for Cr₂O₃(0001) [1]. These activated molecules may further react and could contribute to the chemistry required for so-called “climate engineering”.

In this contribution, we systematically study CO₂ adsorption on metal-doped Fe₃O₄(111) surfaces using Co, Cu, and Au. We find distinct adsorption behavior depending on the metal dopant. While Cu adatoms stabilize either carbonate or carboxylate species, Co favors the formation of oxalate adspecies (see Figure 1) as predicted by density functional theory.

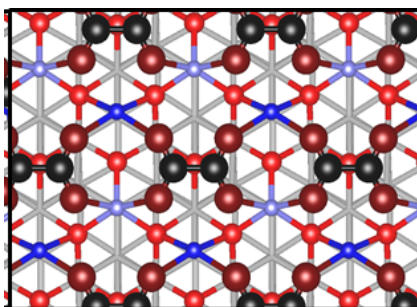


Figure 1. CO₂ adsorbed on a Co-doped Fe₃O₄(111) surface.

References:

- [1] H. Kühlenbeck et al., Phys. Chem. Chem. Phys. 96, 15 (1992).