CO depletion: a microscopic perspective.

Stephanie Cazaux*†[1]

[1]Delft University of Technology (TU Delft) – Netherlands

Abstract

In regions where stars form, variations in density and temperature can cause gas to freeze-out onto dust grains forming ice mantles, which influences the chemical composition of a cloud. To understand in detail the depletion (and desorption) of CO on (from) interstellar dust grains, experiments were performed under two different (astrophysically relevant) conditions. In parallel, Kinetic Monte Carlo simulations were used to mimic the experimental conditions.We found that CO molecules accrete onto water ice at temperatures below 27 K, with a deposition rate that does not depend on the substrate temperature. During the warm-up phase, the desorption processes do exhibit subtle differences indicating the presence of weakly bound CO molecules, therefore highlighting CO bound with different energies and with a low diffusion efficiency. IR measurements following the ice thickness during the TPD confirm that diffusion occurs at temperatures close to the desorption. Applied to astrophysical conditions, in a pre-stellar core, the binding energies of CO molecules, ranging between 300 K and 850 K, depend on the conditions at which CO has been deposited. Because of this wide range of binding energies, the depletion of CO as a function of AV is much less important than initially thought. The weakly bound molecules, easily released into the gas phase through evaporation, change the balance between accretion and desorption, which result in a larger abundance of CO at high extinctions. In addition, weakly bound CO molecules are also be more mobile, and this could increase the reactivity within interstellar ices.

*Speaker

†Corresponding author: