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CO_2 formation through radical-molecule reactions on a solid surface inside dense molecular clouds.

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Solid CO_2 is ubiquitously distributed in icy grain mantles in molecular clouds. Since gas phase reactions cannot explain the observed abundance of CO_2 in those environments and CO is also abundant in the ice, CO_2 is considered to form on the surface of icy grains. It has been experimentally demonstrated that CO_2 is formed in interstellar ice analogues processed by UV, ions, or electrons. Recent astronomical observations found solid CO_2 in dense molecular clouds, where the UV field is weak, implying that there should be additional routes to the formation of CO_2 besides UV photolysis. We performed the experiment on surface reactions of CO with cold OH radicals to investigate a possible CO_2 formation route in dense molecular clouds.

OH radicals were produced by dissociating H_2O molecules in microwave-induced plasma and cooled to 100 K before reaction. CO and OH radicals were continuously codeposited onto an Al substrate at 10-40 K. Reaction products were monitored in-situ by FTIR. We found that the formation of CO_2 occurred at all temperatures investigated. Up to 10 % of CO was converted into CO_2 under the present experimental conditions. We propose that surface reactions of CO with non-energetic OH radicals are potential pathways to the formation of CO_2 in dense molecular clouds.

Keywords: interstellar molecular clouds, chemical evolution, carbon dioxide, radical-molecule reactions