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Interactions of oxalic acid and ice on Cu surface

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Understanding the interaction between oxalic acid ($C_2H_2O_4$) and ice is important to heterogeneous reactions occurring in the polar boundary-layer, in particular, to advance our knowledge of bromine activation/deactivation associated with $C_2H_2O_4$ near snow/ice surfaces. We have studied the interactions between $C_2H_2O_4$ and H_2O on a polycrystalline Cu surface with reflection-absorption infrared spectroscopy and temperature programmed desorption (TPD) methods. The $H_2O/C_2H_2O_4$ and $C_2H_2O_4/H_2O$ interfaces and the co-deposited $C_2H_2O_4+H_2O$ system were prepared on the Cu surface by varying deposition sequences of gaseous $C_2H_2O_4$ and H_2O at 155 K. We found that the interaction between ice and $C_2H_2O_4$ does not lead to the H_2O -induced deprotonation of $C_2H_2O_4$ in a temperature range 155–283 K. However, H-bonding interactions between H_2O and $C_2H_2O_4$ can lead to the formation of a metastable oxalic acid-ice complex in the $C_2H_2O_4/H_2O$ and $C_2H_2O_4+H_2O$ systems during the TPD process. Desorption of H_2O from the $C_2H_2O_4/H_2O$ system is suggested to involve the diffusion of H_2O through the top $C_2H_2O_4$ layer. In the $C_2H_2O_4+H_2O$ system, H_2O desorption is followed by a rearrangement of $C_2H_2O_4$ to form a $C_2H_2O_4$ adlayer on Cu. Our experimental findings suggest that $C_2H_2O_4$ is not ionized on snow and ice in the polar boundary-layer and at upper tropospheric temperatures (~240 K).