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Interfacial Acid Base Chemistry

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Cloud formation, atmospheric chemistry, and human health are influenced by multiphase chemistry at the air-substrate interface of atmospheric particles and ground surfaces (Pöschl and Shiraiwa 2015). All of these impacts are affected by acidity (Angle et al. 2021). A conceptional understanding of interfacial acid-base character has not yet been reached (Saykally 2013). Using X-ray photoemission spectroscopy at near ambient pressure, we have suggested that the dissociation of acids adsorbed to ice is governed by the availability and mobility of water molecules to stabilize the dissociated ions and that the degree of dissociation at the air-ice interface differs from that predicted based on dissociation behavior in aqueous bulk solutions (Bartels-Rausch et al. 2017, Kong et al. 2017). Ice and snow host chemistry of relevance for the atmosphere and are of importance in cold regions of the Earth (Thomas et al. 2019). Here, we present additional results of fundamental studies on the structure of the hydrogen bonding network of interfacial water and the dissociation of acidic trace gases upon adsorption. REFERENCES Angle, K. J., D. R. Crocker, R. M. C. Simpson, K. J. Mayer, L. A. Garofalo, A. N. Moore, S. L. Mora Garcia, V. W. Or, S. Srinivasan, M. Farhan, J. S. Sauer, C. Lee, M. A. Pothier, D. K. Farmer, T. R. Martz, T. H. Bertram, C. D. Cappa, K. A. Prather and V. H. Grassian (2021). "Acidity across the interface from the ocean surface to sea spray aerosol." Proc Natl Acad Sci U S A 118(2). Bartels-Rausch, T., F. Orlando, X. Kong, L. Artiglia and M. Ammann (2017). "Experimental evidence for the formation of solvation shells by soluble species at a nonuniform air-ice interface." ACS Earth and Space Chemistry 1(9): 572-579. Kong, X., A. Waldner, F. Orlando, L. Artiglia, T. Huthwelker, M. Ammann and T. Bartels-Rausch (2017). "Coexistence of physisorbed and solvated HCl at warm ice surfaces." Journal of Physical Chemistry Letters 8(19): 4757-4762. Pöschl, U. and M. Shiraiwa (2015). "Multiphase chemistry at the atmosphere–biosphere interface influencing climate and public health in the anthropocene." Chemical Reviews 115(10): 4440-4475. Saykally, R. J. (2013). "Air/water interface: Two sides of the acid-base story." Nature Chemistry 5(2): 82-84. Thomas, J. L., J. Stutz, M. M. Frey, T. Bartels-Rausch, K. Altieri, F. Baladima, J. Browse, M. Dall'Osto, L. Marelle, J. Mouginot, G. M. Jennifer, D. Nomura, K. A. Pratt, M. D. Willis, P. Zieger, J. Abbatt, T. A. Douglas, M. C. Facchini, J. France, A. E. Jones, K. Kim, P. A. Matrai, V. F. McNeill, A. Saiz-Lopez, P. Shepson, N. Steiner, K. S. Law, S. R. Arnold, B. Delille, J. Schmale, J. E. Sonke, A. Dommergue, D. Voisin, M. L. Melamed and J. Gier (2019). "Fostering multidisciplinary research on interactions between chemistry, biology, and physics within the coupled cryosphere-atmosphere system." Elementa 7.

Significance

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