FORMIC SULFURIC ANHYDRIDE: A NEW CHEMICAL SPECIES WITH POSSIBLE IMPLICATIONS FOR ATMOSPHERIC AEROSOL

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Aerosols are important players in the Earth's atmosphere, affecting climate, cloud formation, and human health. In this work, we report the discovery of a previously unknown molecule, formic sulfuric anhydride (FSA), that may influence the formation and composition of atmospheric aerosol particles. Five isotopologues of FSA have been observed by microwave spectroscopy and further characterized using DFT calculations. The system has dipole moment components along all three inertial axes, and indeed *a*, *b*, and *c*-type transitions have been observed. A π_2 + π_2 + σ_2 cycloaddition reaction between SO_3 and HCOOH is proposed as a possible mechanism for the formation of FSA and calculations indicate that the transformation is effectively barrierless. Facile formation of the anhydride followed by hydrolysis in small water-containing clusters or liquid droplets may provide a mechanism of incorporating volatile organics into atmospheric aerosol. We suggest that FSA and its derivatives be considered in future atmospheric and climate models.