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Absorption of Soluble Gases by Atmospheric Nanoaerosols

Tov Elperin, Andrew Fominykh, Boris Krasovitov, Alexey Lushnikov

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We investigate mass transfer during absorption of atmospheric trace soluble gases by a single droplet whose size is comparable to the molecular mean free path in air at normal conditions. It is assumed that the trace reactant diffuses to the droplet surface and then reacts with the substances inside the droplet according to the first order rate law. Our analysis applies a flux-matching theory of transport processes in gases and assumes constant thermophysical properties of the gases and liquids. We derive an integral equation of Volterra type for the transient molecular flux density to a liquid droplet and solve it numerically. Numerical calculations are performed for absorption of sulfur dioxide (SO2), dinitrogen trioxide (N2O3) and chlorine (Cl2) by liquid nanoaerosols accompanied by chemical dissociation reaction. It is shown that during gas absorption by nanoaerosols the kinetic effects play significant role, and neglecting kinetic effects leads to significant overestimation of the soluble gas flux into a droplet during all the period of gas absorption.

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