Abstract

This thesis summarizes a series of surface ionization (SI) studies of alkali metal interactions with hot metal and metal oxide surfaces in air at atmospheric pressure. The applicability of the method for surface studies is discussed. The knowledge gained from these studies has been applied in the development of a novel apparatus for *in situ* detection and characterization of individual atmospheric alkali salt particles.

The thesis reports a series of studies where a field reversal (FR) technique has been employed in kinetic studies of alkali ion desorption in air from systems of increasing complexity. The kinetics of alkali ion desorption from a hot platinum surface in air at atmospheric pressure have been determined with the FR technique. The results show excellent agreement with literature values from vacuum studies and confirm the applicability of the SI method to ambient and pressurized conditions. Desorption processes on oxide surfaces are more complex. The formation and decomposition of Rh-oxides provides the opportunity to follow a phase transition in real time. The process of alkali ion desorption is sensitive to changing surface conditions and can therefore be used to monitor surface changes in real time. The formation and subsequent decomposition of rhodium oxide was studied, as well as the desorption of alkali ions from stainless steel. The results confirmed the potential of SI to function as a surface-sensitive probe. The iron catalyst used in ammonia synthesis presents an even more complex system. Measurement of the ionic desorption of potassium, in combination with electron emission data, showed strong dependence on the surface conditions and provided information about the state of the catalyst surface. Atmospheric aerosols are of great importance to the global heat balance. Individual aerosol particles containing alkali metals can be detected by SI. Equipment and methods have been developed. Results of laboratory tests as well as examples of field measurements of sea-salt particles in the ambient atmosphere is presented. The SI detector is shown to function well as an alkali-selective real time particle counter, and possible applications are discussed.

Keywords: Alkali metals, atmospheric pressure, desorption kinetics, surface ionization, iron catalyst, sea-salt, particle detection, atmospheric aerosols

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