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Probing the Electronic Structures and Interfacial Solvation Properties of Aqueous Nanoaerosols via VUV Photoelectron Spectroscopy

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An in-depth understanding of the fundamental energetic and structural properties at or near the interface of nanoscaled aqueous aerosols is of fundamental and crucial importance in understanding the impacts of organic species, either of biogenic or anthropogenic origins in intervening the cloud formation microphysics and the intrinsic nature of clouds. To address these issues, we applied aerosol VUV photoelectron spectroscopy to investigate the valence electronic structures and interfacial characteristics of pure and several organic-containing aqueous nanoaerosols that are of atmospheric significance. Considering that many organic species emitted from anthropogenic activities may encounter fine water nanodroplets and form aqueous aerosols in the atmosphere, we studied the valence photoelectron spectroscopy of phenol and three dihydroxybenzene isomers including catechol, resorcinol, and hydroquinone aqueous nanoaerosols at varying pH conditions. It reveals that the hydration extents, pH values, deprotonation status, and numbers/relative arrangements of –OH groups are crucial factors affecting the ionization energies of phenolic aqueous nanoaerosols and thus their redox-based activities. The multi-faceted implications of the present study in the aerosol science, atmospheric/marine chemistry, and biological science will be addressed.

Keywords: Aerosols; Aerosol VUV photoelectron spectroscopy; Aqueous nanoaerosols; Valence electronic structures; Interfacial solvation structures.

Summary

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