

VUV Photoelectron Spectroscopy of Aqueous Aerosols

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The crucial roles of aerosols have been increasingly recognized in a variety of important research fields, encompassing the atmospheric chemistry, the environmental science and the planetary science. Recently, the implications of aerosols in the biomedical science, pharmaceutical administration and micro-fabrications of nano-structured novel materials have also been actively explored. To probe the valence electronic structure of aerosols, which decisively determines their chemical activities, an aerosol VUV photoelectron spectroscopy apparatus equipped with a high resolution hemispherical energy analyzer has been recently built, using the VUV radiation generated from the undulator beamline (U9) at the National Synchrotron Radiation Research Center (NSRRC) at Hsinchu, Taiwan as the ionization photon source. Preliminary efforts have been focused on studying the aqueous aerosols. By introducing the aqueous samples of interest into the aerosol droplet phase with an average droplet size of ~ 100 nm and collimating them to a focused nanoparticle beam in vacuo via the aerodynamic lens system, this new aerosol apparatus readily creates a microscopic aqueous environment, which allows ones to study the hydrated structure of biologically important materials and extract valuable information that can only be accessed under relevant aqueous conditions, such as the solvent effect, pH effect and the solvent-solute interaction. Recently, we applied this newly constructed aerosol VUV photoelectron spectroscopy apparatus to investigate the valence electronic structure of glycine and cysteine aqueous aerosols for the first time. The effect of pH value on the electronic properties of the chosen aqueous aerosols has been interrogated. Ultimately, due to the significance of aerosols in numerous fields and the crucial role of their electronic structure in determining their chemical activities, this new aerosol VUV photoelectron spectroscopy instrument sheds new lights in advancing our understanding on the fundamental electronic characteristics of aerosols and in unraveling the physical chemistry underlying their significance in various fields.

Keywords: aerosols, aerosol VUV photoelectron spectroscopy, undulator, glycine aqueous aerosols, cysteine aqueous aerosols, pH effect

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