LABORATORY SIMULATIONS OF TITAN'S SURFACE COMPOSITION AND ITS RELATION TO ATMOSPHERIC HAZE LAYERS

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The arrival of the Cassini spacecraft in orbit around Saturn has led to the discovery of benzene at ppm levels, as well as large positive ions evocative of polycyclic aromatic hydrocarbons (PAHs) in Titan's atmosphere. Recently, the assignment of the band at 3.28 μm as observed by the Visual–Infrared Mapping Spectrometer (VIMS) to gas-phase PAHs provides further evidence that these molecules are prevalent on Titan. These observations suggest that aromatic reaction pathways play an important role in the photochemistry of Titan's atmosphere, in particular in the formation of large organic species. These aerosols eventually settle out of the atmosphere onto the surface of Titan giving rise to the different surface albedos that are observed by the VIMS instrument onboard Cassini.

We will present results from a laboratory study of the UV irradiation of ppm-level aromatic precursors to understand their influence on the observable characteristics of Titan's surface. Spectroscopic measurements of our analog aerosols compare favorably to observations of Titan's haze by VIMS and by the Composite Infrared Spectrometer (CIRS) in the far-infrared. In addition, the broad aerosol emission feature centered at approximately 145 $\mathrm{cm}^{-1}$is of particular interest. From the broadness of this feature, we speculate that the emission is a blended composite of low-energy vibrations of large molecules such as polycyclic aromatic hydrocarbons (PAHs) and their nitrogen containing counterparts, polycyclic aromatic nitrogen heterocycles (PANHs). A further comparison of our aerosol spectra to the surface observations carried out by Cassini also shows a strong correlation between the aerosol makeup and the surface albedo of Titan. Using laser desorption mass spectrometry (LDMS) and collision-induced dissociation (CID) MS/MS techniques we confirm the presence of large (5+ rings) PAHs/PANHs in our aerosols and discuss possible formation pathways.