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# Understanding the formation and composition of hazes in planetary atmospheres that contain carbon monoxide

**S.M. Hörst (1)**, Y.H. Yoon (1), R.K. Hicks (1,2), and M.A. Tolbert (1,2)
(1) sarah.horst@colorado.edu, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado-Boulder, CO, USA (2) Department of Chemistry, University of Colorado-Boulder, CO, USA

## Abstract

Measurements from the Cassini Plasma Spectrometer (CAPS) have revealed the presence of molecules in Titan's ionosphere with masses in excess of hundreds of amu. Negative ions with mass/charge (m/z) up to 10,000 amu/q [1] and positive ions with m/z up to 400 amu/q [2] have been detected. CAPS has also observed $O^+$ flowing into Titan's upper atmosphere [3], which appears to originate from Enceladus and is likely the source of oxygen bearing molecules in Titan's atmosphere [4]. The observed $O^+$ is deposited in the region now known to contain large organic molecules. A recent Titan atmosphere simulation experiment has shown that incorporation of oxygen into Titan aerosol analogues results in the formation of all five nucleotide bases and the two smallest amino acids, glycine and alanine [5]. Similar chemical processes may have occurred in the atmosphere of the early Earth, or in the atmospheres of extrasolar planets; atmospheric aerosols may be an important source of the building blocks of life.

Atmospheric aerosols play an important role in determining the radiation budget of an atmosphere and can also provide a wealth of organic material to the surface. The presence of atmospheric aerosols has been invoked to explain the relatively featureless spectrum of HD 189773b, including the lack of predicted atmospheric Na and K spectral lines [9]. The majority of the $O^+$ precipitating into Titan's atmosphere forms CO ($O(^3P)+CH_3$ -> $CO+H_2+H$) [4]. CO has also been detected in the atmospheres of a number of exoplanets including HD 189733b, HD 209458b, and WASP-12b [6-8]. It is therefore important to understand the role CO plays in the formation and composition of hazes in planetary atmospheres.

Using a High-Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS) (see e.g. [10]) we have obtained in situ composition measurements of aerosol particles (so-called "tholins") produced in $N_2/CH_4/CO$ gas mixtures subjected to either FUV radiation (deuterium lamp, 115-400 nm) or a spark discharge for a range of initial CO mixing ratios. A comparison of the composition of tholins produced using the two different energy sources will be presented. The effect of variation of CO mixing ratio on aerosol production and composition will also be discussed.

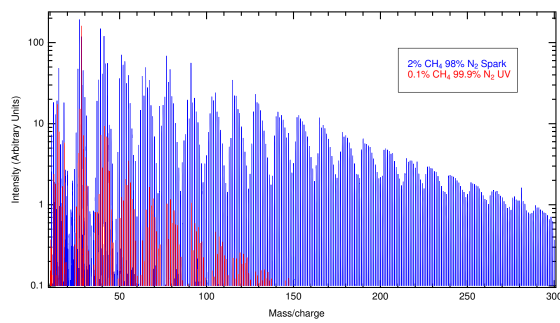


Figure 1: Comparison of typical HR-ToF-AMS mass spectra of tholins produced by spark discharge (blue) and FUV (red).

## References

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