

Title: Investigating Titan's Atmospheric Chemistry at Low Temperature in Support of the NASA Cassini Mission

Authors: Ella Sciamma-O'Brien¹, Farid Salama¹

1. NASA Ames Research Center, Moffett Field, CA, United States.

Abstract: Titan's atmosphere, composed mainly of N₂ and CH₄, is the site of a complex chemistry induced by solar UV radiation and electron bombardment from Saturn's magnetosphere. This organic chemistry occurs at temperatures lower than 200 K and leads to the production of heavy molecules and subsequently solid aerosols that form the orange haze surrounding Titan.

The Titan Haze Simulation (THS) experiment has been developed on the COSMIC simulation chamber at NASA Ames in order to study the different steps of Titan's atmospheric chemistry at low temperature and to provide laboratory data in support for Cassini data analysis. The chemistry is simulated by plasma in the stream of a supersonic expansion. With this unique design, the gas mixture is adiabatically cooled to Titan-like temperature (~150 K) before inducing the chemistry by plasma discharge. Different gas mixtures containing N₂, CH₄, and the first products of the N₂-CH₄ chemistry (C₂H₂, C₂H₄, C₆H₆...) but also heavier molecules such as PAHs or nitrogen containing PAHs can be injected. Both the gas phase and solid phase products resulting from the plasma-induced chemistry can be monitored and analyzed.

Here we present the results of recent gas phase and solid phase studies that highlight the chemical growth evolution when injecting heavier hydrocarbon trace elements in the initial N₂-CH₄ mixture. Due to the short residence time of the gas in the plasma discharge, only the first steps of the chemistry have time to occur in a N₂-CH₄ discharge. However by adding acetylene and benzene to the initial N₂-CH₄ mixture, we can study the intermediate steps of Titan's atmospheric chemistry as well as specific chemical pathways. These results show the uniqueness of the THS experiment to help understand the first and intermediate steps of Titan's atmospheric chemistry as well as specific chemical pathways leading to Titan's haze formation.

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