INVESTIGATING THE DIFFERENT STEPS OF TITAN'S ATMOSPHERIC CHEMISTRY AT LOW TEMPERATURE: SOLID PHASE ANALYSIS. E. Sciamma-O'Brien[1], M. Nuevo[1,2], and F. Salama[1], [1]NASA Ames Research Center, Moffett Field, CA 94035, USA (ella.m.sciammaobrien@nasa.gov), [2]SETI Institute, Mountain View, CA 94043, USA.

Introduction: Titan's atmosphere, composed mainly of N_2 and CH_4, is the siege 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 around Titan. Since 2004, the instruments onboard the Cassini orbiter have generated large amounts of observational data, unraveling an atmospheric chemistry on Titan much more complex than what was first expected, particularly in the upper atmosphere. Neutral, positively and negatively charged heavy molecules have been detected in the ionosphere of Titan[1,2], including benzene (C_6H_6) and toluene ($C_6H_5CH_3$)[3]. The presence of these critical precursors of polycyclic aromatic hydrocarbon (PAH) compounds suggests that PAHs might play a role in the production of Titan's aerosols.

The Titan Haze Simulation (THS) Experiment: The THS experiment has been developed on the COSmIC simulation chamber at NASA Ames to study the different steps of Titan's atmospheric chemistry at low temperature. 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 N_2, CH_4, and the first products of the N_2-CH_4 chemistry (C_2H_2, C_2H_4, C_6H_6, …), but also heavier molecules such as PAHs or nitrogen containing PAHs (PANHs) can be injected to study specific chemical pathways. Both the gas phase and solid phase products resulting from the plasma-induced chemistry can be monitored and analyzed. Cavity ring down spectroscopy[4] and mass spectrometry[5] are used for the gas phase analysis; Scanning Electron Microscopy (SEM), Gas Chromatography-Mass Spectrometry (GC-MS), mass spectrometry and IR spectroscopy are used for the solid phase analysis.

Gas phase analysis: A recent mass spectrometry study of the gas phase[6] has shown the potential of the THS experiment to study the first and intermediate steps of Titan's atmospheric chemistry due to the short residence time of the gas in the pulsed plasma discharge. N_2-CH_4, N_2-CH_4-C_2H_2 and N_2-CH_4-C_6H_6 mixtures were used to highlight the chemical growth evolution when injecting heavier hydrocarbon trace elements in the initial N_2-CH_4 mixture (cf. LPSC abstract on gas phase).

Solid phase analysis: Here we present the first results of the complementary solid-phase analysis performed on Titan tholins produced in the THS experiment with the same gas mixtures as those used for the gas phase analysis. Thin tholin films were deposited onto various substrates for use with the different methods of analysis that are available to our team (IR spectroscopy, GC-MS, mass spectrometry). As a preliminary result for this study, Figure 1 shows the IR absorption spectrum of tholins deposited on a KBr window for 20 hours from a N_2-CH_4 (95:5) gas mixture. A comparison between THS tholins produced in different gas mixtures will be given, as well as with tholins produced by other laboratories. We will also compare our plasma-generated tholin films to tholin films produced in a static photochemistry cell using VUV instead of plasma as the energy source for the chemistry.

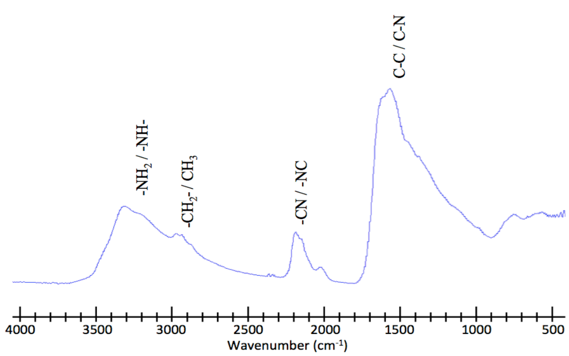

Figure 1: IR spectrum of N_2-CH_4 (95:5) tholin film produced in the THS experiment and deposited on a KBr window.

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