DETECTION AND REACTIVITY OF TITAN THOLINS IN LIQUID HYDROCARBONS. K. Dzurilla[1], V. Chevrier[1], D. Nna Mvondo[2], D. Mège[3], K. Farnsworth[1]. [1]University of Arkansas, Center for Space and Planetary Sciences, University of Arkansas, Fayetteville, AR 72701. (Kadzuril@uark.edu), [2]Universities Space Research Association, NASA Goddard Space Flight Research Center, NASA/GSFC (691, Greenbelt , MD 20771, delphine.nnamvondo@nasa.gov), [3]Laboratoire de Planétologie et Géodynamique de Nantes, CNRS, Université de Nantes (Building 4 Faculté des Sciences et Techniques 2 rue de la Houssinière - BP 92208 44322 Nantes Cedex 3 (FRANCE) daniel.mege@univ-nantes.fr).

Introduction: Tholins are organic molecules produced via methane photolysis in Titan's upper atmosphere. These long-chained hydrocarbons fall to the moon surface and interact with liquid hydrocarbons, via methane rain [1, 2, 3, 4, 5, 6, 7, 8, 9] and methane-ethane-nitrogen dominated lakes and seas. However, preliminary studies have shown that tholins are only weakly soluble in non-polar solvents such as methane and ethane [10, 11, 12, 13]

Previous studies have shown biologically significant compounds present under certain conditions. Kawai et al. [12] and He et al. [13] found Amino acids and Nitriles, along with Glycine, Alanine and other amino acids produced in certain solvents. Studies have found that the solubility of tholins increases as the polarity of the solvent increase [13]. We plan to determine the solubility of Titan tholins, as well as structurally similar compounds, in solutions of liquid hydrocarbons using acrylonitrile, acetonitrile, and hexane mixtures.

Tholin Composition. As there has never been an analysis of tholins produced on Titan, the theoretical composition has been determined using a plasma discharge and an N_2-CH_4 gas mixture [14].

Tholins produced in these environments were found to be oligomeric and polymetric chain and ring configurations containing Carbon, Hydrogen, and Nitrogen. Single as well as multiple bonds are also expected in these structures. Nuclear magnetic resonance (NMR) studies performed on these tholin samples have found nitriles, amines, methyl, and (theoretically) Triazine and Melamine (Derenne et al., 2012). Other compounds were calculated to be mathematically possible, however were not confirmed. (Isocyano, heterocyclic amines, ammonia groups, carbodiimide, aerobatic hydrocarbons, hydrazines, hydroazones, and diazo compounds). Specific structures of these groups have been simulated only theoretically [1].

Experiment: While the exact composition of tholins is unknown, polyacrylonitrile, polypyrrole, polyaminocyanomethylene, polyaminomalononitrile, and polycyanoacetylenes incorporating acetylene or HC_3N/C_2H_2 copolymers will be used as simpler structural models. As such, these polymers will be dissolved in acrylonitrile, acetonitrile, and hexane solutions.

Tholin Production. This study utilizes a cold plasma discharge (approx. 27mA) simulating charge particle radiation interacting in a 90% Nitrogen and 10% Methane gas mixture (simulating Titan's atmosphere) to synthesize Titan tholins (as seen in Figure 1). Chamber conditions of 0.5 Torr - 3.00 Torr were maintained at room temperature for approximately 3 days with a continuous flow of N_2-CH_4 gas mixture.

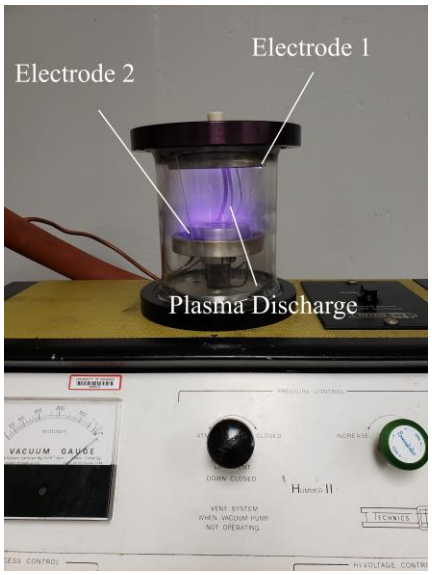

Figure 1: Technics Hummer II sputtering system shown with DC cold plasma discharge at 30mA.

Glass slides positions inside the glass chamber collected tholin deposits (Figure 2). Approximately 200mg of synthesized Titan tholins were produced from this process.

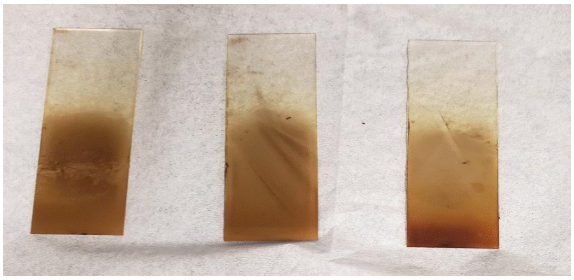

Figure 2: Tholins produced using the experimental conditions

Methods. Solvents of acrylonitrile, acetonitrile, and hexane mixtures at room temperature and pressure are used to dissolve the organic structures. Tholins as well as the structural models will be added to the solvents for 2-3 hours.

The liquid phase is extracted and analyzed for any observed changes. Results from the tholins will be compared to reference data obtained with the simpler polymers.

Conclusion: This study aims to investigate the astrobiological significance of Titan and its complex organic molecules on the surface. Reactions between these organic molecules and their complex processes will give insight into the habitability of Titan. In the future, these experiments conducted at Titan temperature and pressure could provide relevant results.

These experiments will provide information on what types of complex organic molecules are present on the surface of Titan. Results of these experiments will provide details on the structure of tholins.

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