# The role of organic haze in the hydrogen cycle on Titan

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In Titan's atmosphere, a large number of atomic hydrogen is produced during the photochemical reactions. These reactive H atoms may have a significant effect on the formation of complex organics in the atmosphere. The H atoms are considered to be consumed by the subsequent reactions with other molecules and thereby to modify the chemical composition of the atmosphere. The previous theoretical studies have suggested that atomic hydrogen reacts with aerosol to form H2 molecule in Titan's atmosphere. However, there are no laboratory experiments about the heterogeneous reactions. In this study, we irradiated atomic deuterium onto Titan tholin and investigated the mechanisms and kinetics of the heterogeneous reactions. Our experimental results indicate that the heterogeneous reactions are mainly composed of two reactions under the conditions of Titan's atmosphere; the addition of atomic deuterium into tholin (hydrogenation) and the abstraction of H contained in tholin by forming HD (HD recombination). We obtained the reaction probabilities of these reactions and introduced them into one-dimensional photochemical model. The calculation results suggest that the presence of aerosol in the atmosphere accelerates the conversion of CH4 to complex organics. The possible effects of the heterogeneous reactions on the evolution of Titan's atmosphere are also discussed.