Geophysical Research Abstracts
Vol. 16, EGU2014-11161, 2014
EGU General Assembly 2014

Review on optical constants of Titan aerosols: Experimental results and modeling/observational data

Coralie Brassé (1), Olga Muñoz (2), Patrice Coll (1), and François Raulin (1)

(1) Université Paris Est Créteil et Paris Diderot, Laboratoire Inter-universitaire des Systèmes Atmosphériques, CRETEIL, France (coralie.brasse@lisa.u-pec.fr), (2) Instituto de Astrofísica de Andalucía, CSIC, Granada, Spain (olga@iaa.es)

During the last years many studies have been performed to improve the experimental database of optical constants of Titan aerosols. Indeed, the determination of the optical constants of these particles is essential to quantify their capacity to absorb and to scatter solar radiation, and thus to evaluate their role on Titan's radiative balance and climate. The study of optical properties is also crucial to analyze and to better interpret many of Titan's observational data, in particular those acquired during the Cassini-Huygens mission.

One way to determine Titan aerosols optical constant is to measure the optical constants of analogues of Titan complex organic material synthesized in the laboratory, usually named Titan's tholins (Sagan and Khare, 1979). But the optical constants depend on the chemical composition, the size and the shape of particles (Raulin et al., 2012). Those three parameters result from the experimental conditions such as energy source, gas mixing ratio, gas pressure, flow rate and irradiation time (Cable et al., 2012). Besides the determination of the refractive index in the laboratory, there are others methods using theoretical models or observational data. Nevertheless, theoretical models are based on laboratory data or/and observational data.

The visible – near infrared spectral region of optical constants has been widely studied with laboratory analogues. Comparison of the obtained results suggest that tholins synthesized by Tran et al. (2003) and Majhoub et al. (2012) are the best representative of Titan aerosols with regards to their refractive indexes in this spectral region. The mid-infrared spectral range has been studied only by Imanaka et al. (2012) and slightly by Tran et al. (2003). In that spectral range, Titan tholins do not exhibit the features displayed by Kim and Courtin (2013) from Titan's observations. For spectral region of wavelengths smaller than 0.20μm or higher than 25μm, only the data from Khare et al. (1984) are available. Therefore it would be very useful to get more laboratory data and especially from Tran et al (2013), Mahjoub et al. (2012) and Imanaka et al. (2012) samples in these spectral regions since their refractive indexes match observational and theoretical data in other spectral ranges.

This presentation will critically summarize these recent results and present detailled constraints on the optical constants Titan's aerosols. In addition, specific lacks of data will be highlighted as well as some possible investigations to be carried out to fill these gaps.

References:

Cable, M. L., et al., 2012. Titan Tholins: Simulating Titan Organic Chemistry in the Cassini-Huygens Era. Chemical Reviews. 112, 1882-1909.
Imanaka, H., et al., 2012. Optical constants of Titan tholins at mid-infrared wavelengths (2.5-25 μm) and the possible chemical nature of Titan's haze particles. Icarus. 218, 247-261.
Khare, B. N., et al., 1984. Optical-Constants of Organic Tholins Produced in a Simulated Titanian Atmosphere - from Soft-X-Ray to Microwave-Frequencies. Icarus. 60, 127-137.
Kim, S. J., Courtin, R., 2013. Spectral characteristics of the Titanian haze at $1-5$ micron from Cassini/VIMS solar occultation data. Astronomy & Astrophysics. 557, L6.
Mahjoub, A., et al., 2012. Influence of methane concentration on the optical indices of Titan's aerosols analogues. Icarus. 221, 670-677.
Raulin, F., et al., 2012. Prebiotic-like chemistry on Titan. Chemical Society Reviews. 41, 5380-5393.
Sagan, C., Khare, B. N., 1979. Tholins - Organic-Chemistry of Inter-Stellar Grains and Gas. Nature. 277, 102-107.
Tran, B. N., et al., 2003. Simulation of Titan haze formation using a photochemical flow reactor - The optical

constants of the polymer. Icarus. 165, 379-390.

Acknowledgements:
We acknowledge support from the French Space Agency (CNES) and the European Space Agency (ESA).