The lifecycle of particles on cold dust: a complete journey

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In the interstellar medium, gas particles (atoms and molecules) continually collide with cold dust grain. These collisions can lead to the sticking of gas particles on the surface and the "formation" of an ad-particle. The solid state physical-chemistry of ad-particles is governed by three processes (and their respective probabilities): diffusion, interaction of reactants on the surface, and desorption. The focus of this talk is the investigation of these processes with a particular regard on oxidation chemistry.

The presented experiments have been performed with the FORMOLISM set-up, located in the Université de Cergy Pontoise, Observatoire de Paris. Via a triply differentially pumped beam, atoms and molecules are aimed at a cold (>6 K) sample held in the UHV chamber. The products are probed using Temperature Programmed Desorption and Reflexion Absorption Infrared Spectroscopy.

All these studies reveal that solid state chemistry is governed by a desorption-diffusion-reaction competition. If desorption mechanism dominates, physisorbed reactive partners cannot increase the molecular complexity. Conversely, if diffusion mechanisms are preponderant, mobile atoms will be able to scan the surface affecting abundance and variety of the species eventually created.

References

1. Minissale, M., Congiu, E., Manicò, G., Pirronello, V., and Dulieu, F., *CO_2 formation on interstellar dust grains: a detailed study of the barrier of the CO+O channel*, Astronomy and Astrophysics, Vol 559, pp. A49-57 (2013)

2. Minissale, M., Congiu, E., and Dulieu, F., *Oxygen diffusion and reactivity at low temperature on bare amorphous olivine-type silicate*, The Journal of Chemical Physics, Vol 140, pp.074705 (2014)

3. Minissale, M., Fedoseev, G., Congiu, E., Ioppolo, S., Dulieu, F., and Linnartz, H., *Solid state chemistry of nitrogen oxides - Part I: surface consumption of NO*, Physical Chemistry Chemical Physics, Vol 16, pp. 8257-8270 (2014)

4. Minissale, M., Loison, J-C., Baouche, S., Chaabouni, H., Congiu, E., and Dulieu, F., *Solid-state formation of CO_2 via the H_2CO + O reaction*, Astronomy and Astrophysics (2015) DOI: http://dx.doi.org/10.1051/0004-6361/201424342