Geophysical Research Abstracts
Vol. 19, EGU2017-8803, 2017
EGU General Assembly 2017

Effect of non-planarity on the desorption process at the surface of icy grains: consequences on O_2 formation.

Romain Maggiolo (1), Gaël Cessateur (1), Johan De Keyser (1), Frederik Dhooge (1), Andrew Gibbons (1,2), Guillaume Gronoff (3,4), Herbert Gunell (1), Olivier Mousis (5), Nathalie Vaek (2), Jérôme Loreau (2), and Enzo Bonnal (1)

(1) Royal Belgian Institute for Space Aeronomy, Brussels, Belgium (romain.maggiolo@aeronomie.be), (2) Université Libre de Belgique, Brussels, Belgium, (3) Science Directorate, Chemistry and Dynamics Branch, NASA Langley Research Center, Hampton, Virginia, USA, (4) SSAI, Hampton, Virginia, USA, (5) Aix Marseille Université/CNRS, Marseille, France

Molecular cloud and protosolar nebula chemistry involves a strong interaction between the gas phase and the surface of icy grains. The growth and composition of the icy mantle of grains is determined by chemical reactions, and adsorption and desorption rates at the surface.. Because the surface of icy grains is highly porous and uneven, desorbed atoms and molecules have a significant probability to collide with it again and be recaptured. Using a simple model we estimate the effects of recapture on atomic and molecular exchange between the solid and gas phases. We show that on uneven or porous surfaces, hydrogen is more likely, compared to a planar surface, to out-diffuse from the grain than heavier species. We estimate the impact of this enhanced hydrogen escape on the composition of the icy mantle. We focus in particular on the production of O_2 since unexpectedly large amounts of it, probably incorporated in the comet when it formed, have been detected in the coma of comet 67P by Rosetta. In order to reproduce such large amounts of O_2 in the solid phase, models of molecular clouds or protosolar nebulae must overproduce O_2 in the gas phase. Our results suggest that the higher escape probability of H on non-planar surfaces can contribute to enhance the production of O_2 in the icy mantles of grains while keeping its abundance low in the gas phase.