ADSORPTION WATER ON MARS - SET-UP OF A PHOTOCHEMICAL TESTS CHAMBER AND FIRST RESULTS

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Since the Viking missions Mars has been considered as an oxidised desert. No organic material (except for methane, v. i.) like amino acids could be detected although it is continously introduced on Mars by meteorites.

On the other hand it is known from the photochemical water purification with Fenton chemistry that the combination of trivalent iron, light (ultraviolet and visible) and water is able to oxidise almost all organic compounds to minerals [1].

As light, trivalent iron (e. g. as hematite) and water traces are present on Mars the question arose, whether reactions on Mars minerals analogous to those known from aqueous solutions could contribute to explain the discussed lack of organic material.

First tests with isopropyl alcohol as model organic compound, UV-Vis-light and wetted hematite powder clearly indicated the formation of carbon dioxide as a result of a photochemical oxidation under non-classical Photo-Fenton conditions [2].

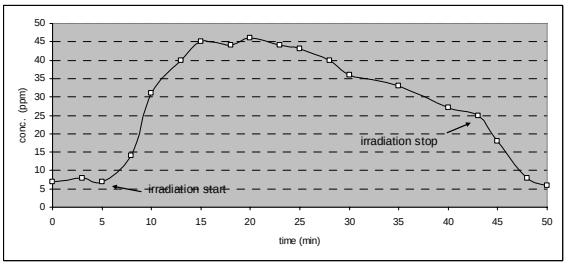

Fig. 1: Formation of carbon dioxide on irradiation of hematite powder with a mercury arc lamp in presence of isopropyl alcohol in nitrogen under normal pressure.

These first results encouraged us to investigate these oxidation processes on surfaces in detail. We had to construct a Mars simulation chamber to reduce the water amount in the experiment significantly and special sample holder to gain control of the reaction temperature.

A set-up for experiments in ultra-high vaccum was chosen in order to study monolayers of water on a hematite single crystal.

A vacuum chamber was constructed with sample holders that allows cooling with liquid nitrogen and thermal programmed desorption to study adsorbates. Gas analysis is accomplished by a quadrupol mass analyzer. A solar simulator (Xenon arc lamp) is used as radiation source.

First experiments were performed with methane as a model compound as its presence in the Martian atmosphere was confirmed lately by Formisano [3].

The experiments indicate clearly the formation of carbon dioxide as the only product of the photochemical oxidation of methane in the presence of water traces.

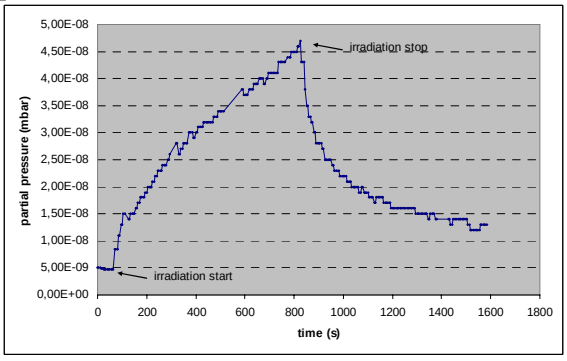

Fig. 2: Formation of carbon dioxide on irradiation of hematite single crystal with a solar simulator in presence of methane and traces of water under high vacuum conditions.

We could thereby show for the first time that photocatalytical processes on surfaces are important for Martian chemistry.

The dependence of the reaction rate from the the boundary conditions like temperature, wavelength and gas composition has now to be studied to get a data basis for simulations.

Besides the investigation of gaseous compounds, non-volatiles like amino acids have to be checked for their behaviour in photochemical reactions on Mars minerals.

References: [1] Spacek, W. et al. (1995) *Chemosphere, 30*, 477-484. [2] Möhlmann, D. (2004) *Icarus, 168*, 318. [3] Formisano, V. (2004) *Science, 306*, 1758.