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Scientific Report

Spectroscopic Investigation of Shock Radical Chemistry

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One of the typical applications of AALGG include re-creating impacts from small-scale space debris and also the simulation of larger impact events (i.e. meteorite impacts) in the laboratory. Our laboratory at J. Heyrovský Institute of Physical Chemistry uses different experimental approaches in this field.The plasma formed by the impact of an extraterrestrial body is simulated using the high-power laser PALS (Prague Asterix Laser System).

Our previous activity in the field of Origin of life (biomolecules) in high energy plasma was focused on application of advanced spectroscopic techniques, theoretical quantum-chemical calculations, plasma chemistry modelling and high-density energy events simulation using high-power lasers or powerful sources of radiation in fundamental exploration of chemical transformations during planetary evolution, leading to formation of basic molecules of living structures on planetary surfaces or directly in the interstellar space. Radiation sources of both participating institutes have been utilized in this research. In cooperation with the Open University, we are going to extend these studies to resistance of microbes after exposition of living cells to shock waves induced by laser breakdown in dielectric gases simulating primordial atmosphere. Recent results published by our group in top journals show formation of biomolecules upon shock waves. This new idea significantly extends previous orientation of the research.

As in our previous studies, the impact will be simulated by the Prague Asterix Laser System. This high–powered laser is based on iodine photodissociation laser with a wavelength of 1315 nm. Amplifiers generate the laser radiation by flash photolysis of isopropyliodide (C3F7I). The peak energy of the laser reaches 1 kJ and, because of the pulse width of ≈ 400 ps, power tp to 3 TW is obtained. Usually, a 150 J pulse with time duration ≈400 ps is used for irradiation of chemical targets. The laser is placed in the building of the Institute of Plasma Physics AS CR. The dielectric gas represents an atmosphere containing a relatively hot, dense plasma, and a solid or liquid target represents the surface exposed to a shock wave. In the vacuum sealed cell, the sample containing microbes will be placed on the bottom of the vessel and exposed to plasma shock wave. After irradiation, all the samples will be transered to Open University for further analysis.

During autumn of early spring 2017, foreing experts from the Open University are going to come to the Czech Republic in order to prepare and attend the experiments.

We can state, that the target of the mission has been accomplished.

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