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INSTITUTO DE PLASMAS
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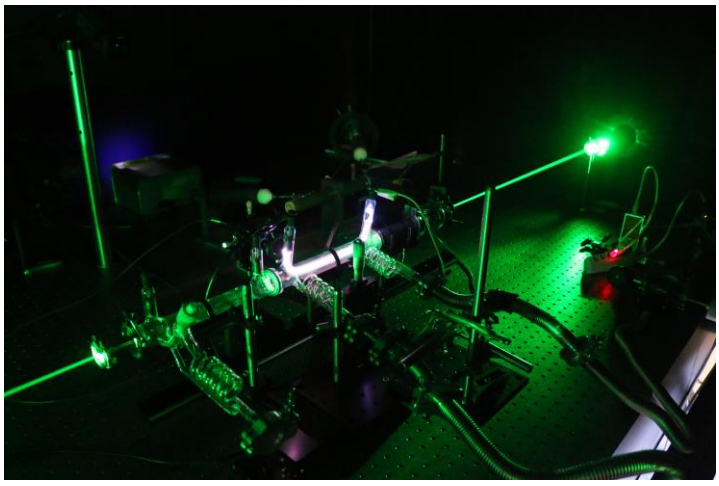
Life on Mars? Astronauts will be able to create oxygen using plasmas

A new method allows transforming carbon dioxide into oxygen, tackling one of the major challenges for humans to live on the red planet.

Breathing on Mars – one of the greatest challenges for human survival on the planet – may be achieved thanks to plasmas technologies, according to a new study published this week. The work, led by a Portuguese team, involves researchers from the Institute for Plasmas and Nuclear Fusion (IPFN), linked to Instituto Superior Técnico (IST) and the University of Porto, and the École Polytechnique in Paris.



The Martian atmosphere consists of about 96% carbon dioxide, with only residual traces of oxygen. These conditions make human breathing impossible and pose a serious challenge to the eventual exploration and setup of bases on the planet. On the other hand, this atmospheric combination exhibits conditions close to ideal for creating oxygen from the decomposition of carbon dioxide using low-temperature plasmas.

The reuse and valorisation of carbon dioxide on Earth is a rapidly expanding field of research, motivated by the environmental problems of climate change and the production of "green fuels". Low-temperature plasmas are one of the best ways for decomposing this gas – the separation of the molecule into oxygen and carbon monoxide – a process that happens either by colliding with electrons or by transferring energy to different states of excitation.

The main finding of this work is that Mars has excellent conditions for the use of natural resources (*In-Situ Resource Utilization* – ISRU) using plasmas. Beyond its carbon dioxide atmosphere, the cold environment (averaging around -60 °C) and atmospheric pressure (about 150 times smaller than on Earth) can induce the energy transfer effect more significantly than what is achieved on our planet. The low temperature also helps to make chemical reactions slower, which facilitates the separation of molecules formed in the plasma as a result of the decomposition of the carbon dioxide.

The method of decomposition using plasmas can solve two important issues for manned missions to Mars. On the one hand, it can provide a stable and reliable supply of oxygen to breathe; on the other hand, it can be used in the local production of fuels for the return to Earth, since carbon dioxide and oxygen can be used to make fuel mixtures for propelling spaceships.

According to Prof. Vasco Guerra, lead author of the paper, "this ISRU approach can significantly simplify the logistics of a mission to Mars. It will help making the mission more self-sustainable, reducing risks to the crew and decreasing the cost of the mission, which will require fewer ships."

This research is led by the Institute for Plasmas and Nuclear Fusion from Instituto Superior Técnico, University of Lisbon, and includes as partners the Faculty of Engineering of the University of Porto and the Laboratory of Physics of Plasmas of the École Polytechnique in Paris. Technische Universitat Eindhoven (The Netherlands) is already involved in the research.

The IPFN / IST team is active at the Alameda campus in Lisbon. The team involves IST / IPFN faculty and researchers as well as a group of young scientists funded by the Foundation for Science and Technology within the scope of the

PREMiERE project (*CO2 Plasmas: the MEDIUM for Renewable Energy*) and the *APPLAuSE* PhD Program in Plasma Science and Engineering.

IPFN is a research unit of Instituto Superior Técnico, University of Lisbon, with the status of Associate Laboratory in the thematic areas of Controlled Nuclear Fusion and Plasma and Intense Lasers Technologies.

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