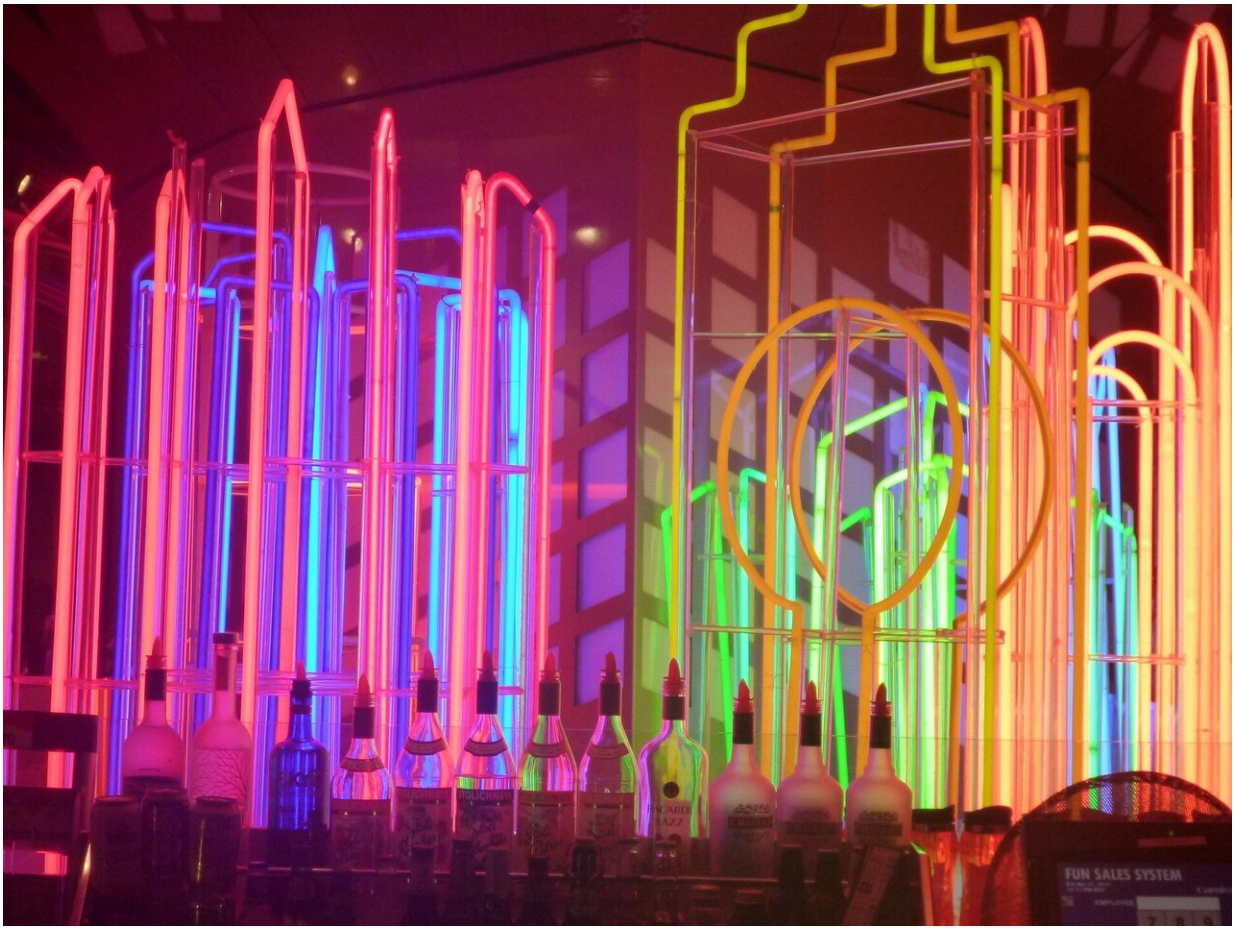
Scientists discover approach to activate inert gases

July 26 2019



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Inert gases like argon typically do not form chemical bonds except under

extreme conditions, such as the icy cold of outer space. As shared in the Proceedings of the National Academy of Sciences, an international team of scientists has developed a groundbreaking approach to design and generate gaseous ions that bind even argon at room temperature. This surprising innovation creates opportunities to activate inert compounds and elements and use them in new ways.

Scientists relied on positively charged ions when trying to bind argon in the past. They deemed these ions "electrophiles" because of an affinity for sharing electrons. The new approach introduces an apparently counterintuitive idea. Special negatively charged ions can act as super-electrophiles. This unique way of looking at binding opens the door to fundamentally new opportunities.

Scientists from Germany's University of Leipzig, University of Wuppertal, and University of Bremen joined with colleagues at the University of the Free State in South Africa, University of Washington, Purdue University, Pacific Northwest National Laboratory, and EMSL, the Environmental Molecular Sciences Laboratory, to answer a puzzling question. Under what well-defined circumstances could negatively charged ions be made reactive enough to bind with argon? They theorized that a scaffolding of negatively charged atoms around a strong positively charged center could be exceptionally reactive and show different binding properties than a highly reactive positively charged ion alone. To validate the concept, they synthesized the most stable doubly negatively charged molecule ever investigated. Refining it further proved that a negatively charged fragment of it could spontaneously bind with argon at room temperature. Using EMSL's Low Temperature Photoelectron Spectroscopy equipment coupled with high-level computational studies, they characterized this molecule as highly reactive and structurally stable. The work could lead to activation of other inert compounds and elements.

More information: M. Mayer, et al. Rational design of an argon-binding superelectrophilic anion. *Proceedings of the National Academy of Sciences*. DOI: 10.1073.pnas.1820812116

Provided by Environmental Molecular Sciences Laboratory

Citation: Scientists discover approach to activate inert gases (2019, July 26) retrieved 9 April 2024 from https://phys.org/news/2019-07-scientists-approach-inert-gases.html

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