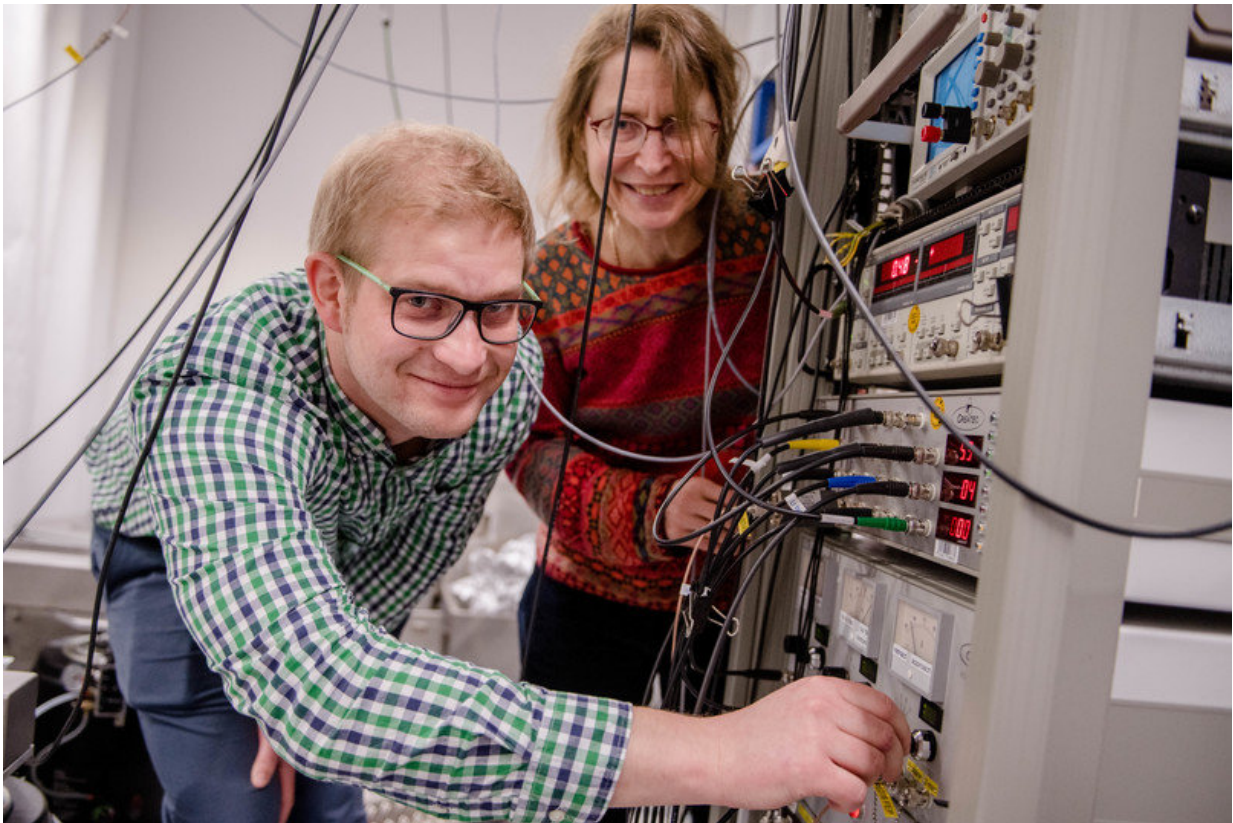


How ice particles promote the formation of radicals

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Karina Morgenstern and Cord Bertram with the experimental setup. Credit: RUB, Marquard

The production of chlorofluorocarbons, which damage the ozone layer, has been banned as far as possible. However, other substances can also

tear holes in the ozone layer in combination with ice particles, such as those found in clouds. Researchers at Ruhr-Universität Bochum, the University of Duisburg-Essen and Friedrich-Alexander-Universität Erlangen-Nürnberg have discovered a possible mechanism for this. They describe it in the journal *Physical Review Letters* on 13 November 2018.

The work was part of a long-standing cooperation between the teams from Bochum, Duisburg-Essen, and Erlangen-Nuremberg led by Professor Karina Morgenstern, Dr. Cord Bertram, Professor Uwe Bovensiepen and Professor Michel Bockstedte, which is currently being continued within the framework of the cluster of excellence Ruhr Explores Solvation, or Resolv for short.

Organic molecules are deposited on ice particles

Chemical processes can significantly influence the weather, the climate and the composition of the atmosphere. Cosmic rays or UV light provide the energy to split chemical compounds. In the case of bromine, chlorine or fluorine compounds, radicals, i.e. particularly reactive molecules, are formed. These attack the ozone molecules and can trigger chain reactions in the [ozone layer](#). An earlier laboratory study had shown that ice particles with a silver core can promote such reactions. The team investigated the mechanism behind this effect in the current study.

In the laboratory, the scientists produced tiny ice particles and analysed how certain compounds containing chlorine or bromine interacted with them. They condensed the ice particles onto copper. In nature, mineral dust particles, among other things, form condensation nuclei for the ice particles.

Using microscopic and spectroscopic methods, they observed that the molecules preferentially attached themselves to defects in the ice structure. The surrounding water molecules of the ice structure then

reoriented themselves and hydrogenated the molecules. This, in turn, made it easier to ionise the molecules in the experiment.

UV radiation generates radicals

The researchers irradiated the ice crystals with the attached molecules using UV light, which excited electrons in the ice particles in the vicinity of the molecules. These excited electrons ionised the chlorine and bromobenzene molecules. Through ionisation, the molecules disintegrated into organic residues and highly reactive chlorine and bromine radicals.

"The mechanism could explain what happens when UV light hits mineral-contaminated ice," says Cord Bertram. "Our results could thus help to understand the fundamental processes behind phenomena such as ozone holes."

More information: Philipp Auburger et al. Microscopic Insight into Electron-Induced Dissociation of Aromatic Molecules on Ice, *Physical Review Letters* (2018). [DOI: 10.1103/PhysRevLett.121.206001](https://doi.org/10.1103/PhysRevLett.121.206001)

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