

Research Center for Eco-Environmental Sciences (CAS) Envisions Environmental Catalytic Cities for Air Pollution Control

These new urban engines with self-purification function are expected to remove air pollution without additional energy consumption

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/EINPresswire.com/ -- Air pollution is a major environmental challenge of this century. In a recent Journal of Environmental Sciences review paper, scientists from the Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, have highlighted potential technologies for direct purification of air pollutants in the environment, including photocatalysis and ambient non-photocatalytic approaches. They also propose the novel concept of an 'Environmental Catalytic City.'



Researchers envision a new engine for air pollution control in the near future.

Over the last century, anthropogenic activities have profoundly impacted the Earth's environment, ushering in the era of climate change and global warming that threatens the sustainability of humankind. Human activities generate and emit particulate matters, volatile organic compounds, as well as inorganic pollutants such as nitrogen oxides, sulfur dioxide, and ammonia, into the troposphere. Notably, precursor volatile organic compounds and nitrogen oxides react in sunlight to form another major pollutant in the form of ozone. These pollutants deteriorate air quality, significantly harm human health, ecosystems, and crop yields, and expedite climate change.

To tackle these challenges head on, governments worldwide have put in place stringent air quality standards and air pollutant emission standards. However, air pollution control still faces several bottlenecks, especially in developing countries, which suffer from severe ozone pollution, require full particulate matter control, and must collaboratively control particulate matter and ozone. While simultaneous precursor control is a promising strategy to reverse ozone rebound, it

is quite difficult to substantially bring down the emission of volatile organic compounds in a short period.

Addressing this concern, a team of researchers from China, led by Hong He from the Laboratory of Atmospheric Environment and Pollution Control, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China, has comprehensively reviewed the next-generation technologies that can directly purify pollutants in the atmospheric environment: photocatalysis and ambient temperature catalysis. Their study, which included researchers from the Institute of Chemistry and the Institute of Urban Environment at Chinese Academy of Sciences, Tsinghua University, and the University of Chinese Academy of Sciences, was made available on 25 February 2025 and has been published in Volume 156 of [the Journal of Environmental Sciences](#) on 1 October 2025.

Hong says: "Ozone air pollution is a major challenge to the improvement of urban environmental quality. Ozone is a typical secondary air pollutant, and its formation chemistry from its precursors is highly nonlinear. As a result, the emission reduction of its precursors is not always effective and therefore new assisted approaches to control ozone pollution are needed. Photocatalysis and ambient catalysis technologies are expected to be applied in open atmosphere as a new booster to the direct purification of air pollutants in emission sources."

Photocatalysis involves the light-induced generation of electron-hole carrier pairs that migrate to surface and initiate redox reactions of adsorbents with various reactive species that degrade pollutants. This green and sustainable technology has been implemented practically in Japan and Europe. However, further progress is necessary in terms of catalyst stability, cost considerations, and engineering applications.

Besides photocatalysis, ambient temperature non-photocatalytic purification is another promising method for air pollutant removal. It involves their decomposition into harmless products such as water, carbon dioxide, and oxygen. This technology is especially useful for the removal of formaldehyde and ozone using TiO₂-supported noble metal and NiFe-layered double hydroxide catalysts, respectively.

Based on these technologies, the research team proposes the novel concept of an 'Environmental Catalytic City.' It refers to the spontaneous purification of low-concentration urban air pollutants in the atmosphere directly using a coating of stable, efficient, and green catalytic materials on artificial surfaces, such as walls of buildings, roads, and radiator surfaces of motor vehicles, in the city. Through this futuristic technology, an urban city with technologically enhanced self-purification function can successfully mitigate air pollution without any additional energy consumption.

"In the future, scientists must strive to develop low-cost catalysts that can efficiently remove ozone and other pollutants, so as to improve the practicability and feasibility of 'Environmental Catalytic City,' and thus provide an additional new engine to better solve the problem of urban

air pollution,” concludes Hong optimistically.

Reference

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About the Research Center for Eco-Environmental Sciences, CAS

Research Center for Eco-Environmental Sciences (RCEES), Chinese Academy of Sciences, established in 1975, is a research institution involved in research on eco-environmental science and technology in China. It currently hosts 473 staff members, including academicians, research, associate, and assistant professors, and junior researchers or administrators working in various areas in its 11 research departments or laboratories. RCEES carries out frontier researches on environmental chemistry, environmental science, and systems ecology and has made historical contribution to the development in the eco-environmental sciences and technology in China.

Website: <http://english.rcees.cas.cn/>

About Hong He from Research Center for Eco-Environmental Sciences, CAS

Hong He leads the Laboratory of Atmospheric Environment and Pollution Control and is a Deputy Director at the Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China. His research interests include environmental catalysis, heterogeneous atmospheric chemistry, and air pollution control technology. He is the author of more than 400 peer-reviewed scientific publications, with over 13,700 citations, and the first inventor on 45 authorized patents. He received his doctorate at the University of Tokyo in 1994.

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