Researchers realize electrochemical conversion of methane and O_2 to HCOOH at room temperature

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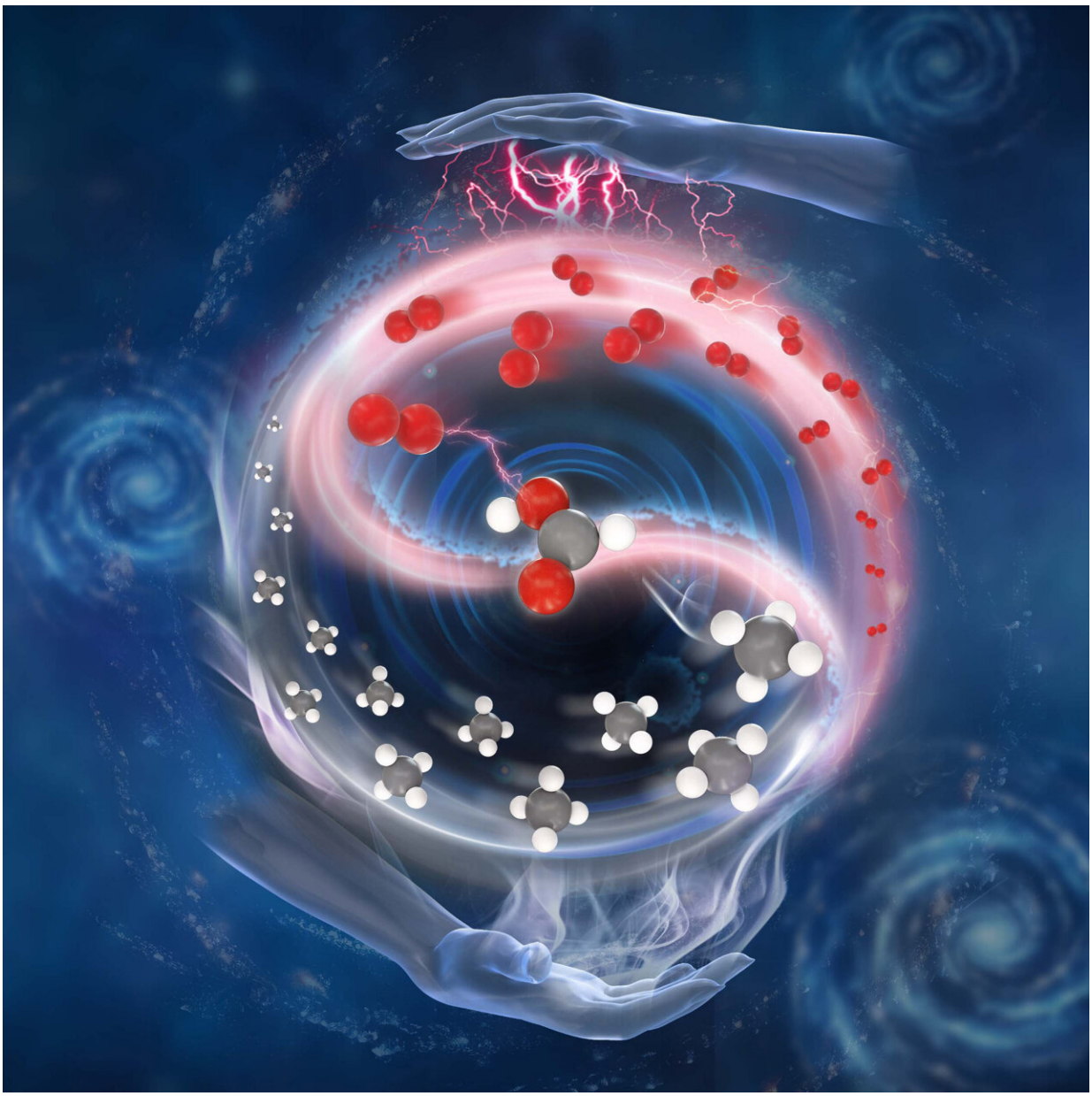

Researchers realize electrochemical conversion of CH4 and O_2 to HCOOH at room temperature. Credit: *Journal of the American Chemical Society*

Direct conversion of CH_4 and O_2 to value-added chemicals is important for natural gas industries. However, challenges remain due to the difficulty of O_2 activation in forming active oxygen species for CH_4 activation under mild conditions.

Recently, a research group led by Prof. Deng Dehui, Assoc. Prof. Cui Xiaoju and Yu Liang from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) realized the electrochemical conversion of CH_4 by O_2 to HCOOH at room temperature. This study was published in *Journal of the American Chemical Society*.

The researchers developed a high-pressure electro-Fenton strategy to establish a hetero-homogeneous process for electro-catalytic conversion of CH_4 by O_2 at room temperature. They revealed that CH_4 was efficiently activated by ·OH, which was produced via a heterogeneous electroreduction of O_2 to H_2O_2 on the Ag foil cathode, followed by a homogeneous Fe^{2+}-facilitated H_2O_2 decomposition.

Additionally, the researchers found that the elevated pressure not only improved the productivity of H_2O_2 from O_2 electro-reduction but also boosted the reaction collision probability between CH_4 and active ·OH in-situ generated from Fe^{2+}-facilitated decomposition of H_2O_2.

Compared with the traditional electro-catalytic CH_4 conversion process with high overpotential (>0.9 V) and low Faradaic efficiency ($^{-1}$ gFe^{-1},

which was 220 times that of ambient pressure.

"This work provides a new way for energy-efficient and sustainable conversion of CH_4 by directly using O_2 under mild conditions," said Prof. Deng.

More information: Yao Song et al, High-Pressure Electro-Fenton Driving CH_4 Conversion by O_2 at Room Temperature, *Journal of the American Chemical Society* (2024). DOI: 10.1021/jacs.3c10825

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