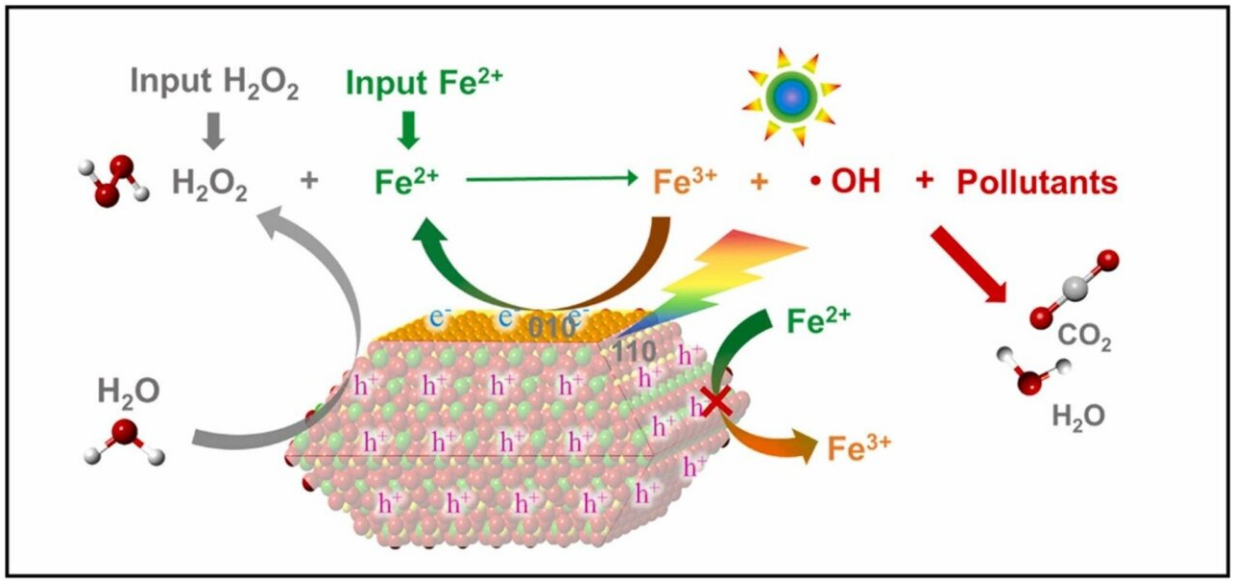
Researchers propose new coupling strategy for organic wastewater treatment

September 13 2022, by Li Yuan



Graphical abstract. Credit: *Applied Catalysis B: Environmental* (2022). DOI: 10.1016/j.apcatb.2022.121858

A joint research group led by Prof. Sun Chenglin, Prof. Wei Huangzhao and Prof. Li Rengui from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) has developed a new coupling strategy of photocatalytic water oxidation and catalytic wet peroxide oxidation (Photo-CWPO) for efficient organic wastewater treatment.

This study was published in *Applied Catalysis B: Environmental* on August 17.

CWPO technology is a kind of advanced oxidation process for advanced treatment of organic wastewater using hydroxyl radical (·OH), which is generated from hydrogen peroxide oxidation catalyzed by Fe^{2+}. Nevertheless, low utilization efficiency of H_2O_2 and difficulty in iron ions cycling lead to high cost and indirect energy consumption, which limits its further large-scale application.

In the proposed Photo-CWPO strategy, efficient circulating of Fe^{3+}/ Fe^{2+} ions was achieved through Fe^{3+} ions reduction by photogenerated electrons, and meanwhile, photogenerated holes were used to degrade organic pollutants.

The researchers used decahedron $BiVO_4$ photocatalyst to realize efficient circulating of Fe^{3+}/ Fe^{2+} ions with selectivity of ~100%, owing to the unique spatial photogenerated charge separation between different facets of the $BiVO_4$ crystal, which inhibited the formation of iron sludge in the traditional CWPO process.

H_2O_2 species could be generated via a two-hole-involved oxidation process of H_2O on {110} facets of decahedron $BiVO_4$ crystals during the Fe^{3+} reduction process on the {010} facets, which could replenish the H_2O_2 consumption and fully utilize both photogenerated electrons and holes for degradation of pollutions. This strategy achieved a much higher total organic carbon removal rate in the coupling system than CWPO process.

"The Photo-CWPO strategy could be applied to mineralize various organic pollutants and showed great universality and stability," said Prof. Sun.

"We have applied this strategy for the treatment of wastewater from coal chemical industry, methanol to olefin industry and unsymmetrical dimethylhydrazine industry, all of which showed good treatment efficiency," said Prof. Wei.

More information: Yue Zhao et al, Coupling photocatalytic water oxidation on decahedron $BiVO_4$ crystals with catalytic wet peroxide oxidation for removing organic pollutions in wastewater, *Applied Catalysis B: Environmental* (2022). DOI: 10.1016/j.apcatb.2022.121858

Provided by Chinese Academy of Sciences