New strategy boosts performance of hydroisomerization

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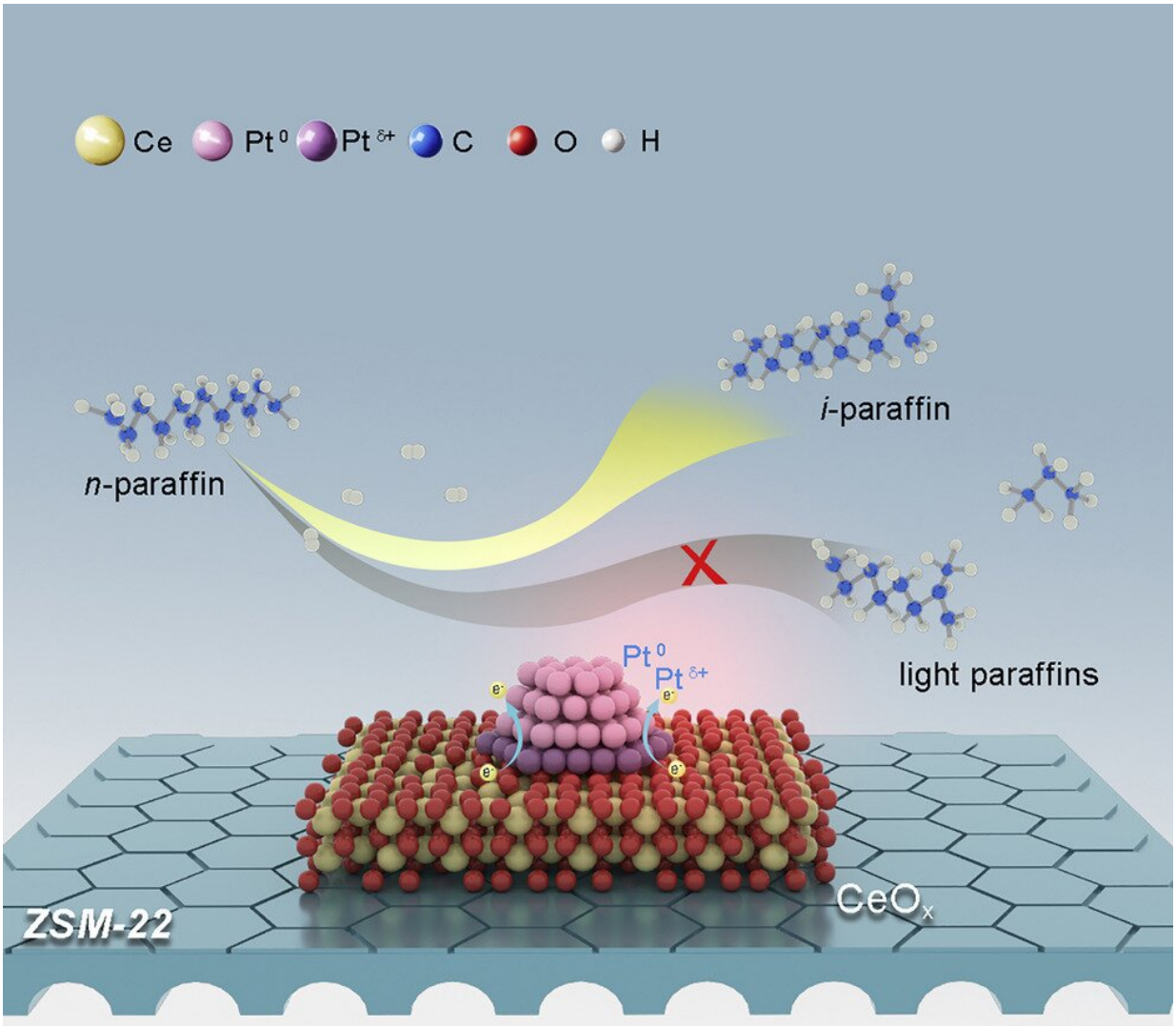

The electron transfer pathway and n-paraffin conversion scheme on the PtCeOX/ZSM-22 catalyst. Credit: Wang Congxin

The n-paraffin hydroisomerization catalyzed by bifunctional catalysts is one of the most important reactions in the chemical industry.

The bifunctional catalyst used in this reaction contains an acid function and a noble metal function. The balance of these two functions is the key for high catalytic performance. Without this balance, the isomerized carbonium ions formed on acid sites will undergo subsequent cracking, giving rise to light alkanes.

Recently, a research group led by Profs. Tian Zhijian and Wang Congxin from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) has developed a new strategy to elevate the intrinsic property of the metal function and prepared a highly-efficient $PtCeO_x$/ZSM-22 catalyst for n-paraffin hydroisomerization reaction.

The study was published in *Chem Catalysis* on Jan. 26.

The researchers proposed a facile sequential impregnation method by taking advantage of the discrepancy in point of zero charge between ZSM-22 support and ceria additive, through which the CeO_x species were formed across the rod-like ZSM-22 support and Pt nano clusters were anchored on the surface of ceria.

They found the electron transfer between Pt and CeO_x. This electron transfer effect brought a significant elevation for the intrinsic activity of the catalyst. It enabled $Pt^{\delta+}$ species to quickly activate C-H bonds in the initial dehydrogenation of the alkanes step and donate the electron to saturate the branched alkenes in the terminal hydrogenation step of n-paraffin hydroisomerization process.

This catalyst (0.3wt%$PtCeO_x$/ZSM-22) showed high performance in n-paraffin hydroisomerization with enhanced turnover frequency, a high isomer selectivity (96%) at high n-paraffin conversion rate (91%), and

an 87% i-paraffin yield, which was superior to the commercial Pt/ZSM-22 catalyst with traditional high Pt content (no less than 0.5wt% Pt).

"This work provides not only new insights into Pt-metal oxide interaction in bifunctional catalysts, but also strategy for efficient bifunctional catalyst manufacture in potential industrial applications," said Prof. Wang.

More information: Yan Peng et al, Boosting catalytic performance via electron transfer effect for hydroisomerization on a low-Pt-content $PtCeO_x$/zeolite catalyst, *Chem Catalysis* (2023). DOI: 10.1016/j.checat.2023.100505

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