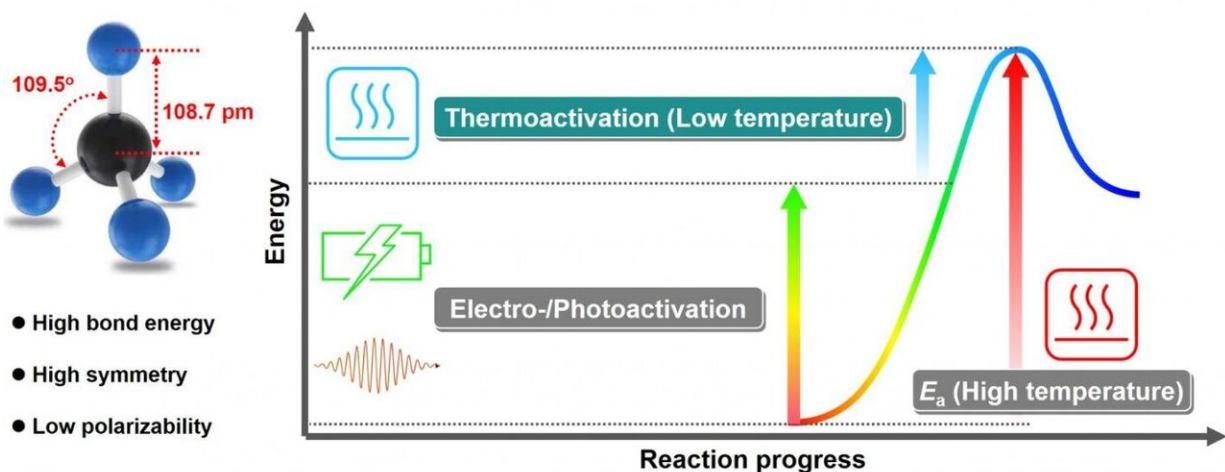


Direct methane conversion under mild conditions by thermo-, electro- or photocatalysis reviewed

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The molecular structure of methane (left) and schematic illustration of an energy diagram for low-temperature methane activation in electro- and photoactivation-involved reaction systems (right). Credit: MENG Xianguang

Direct conversion of Earth-abundant methane into value-added chemicals under mild conditions is an attractive technology in response to the increasing industrial demand for feedstocks and the worldwide appeal of energy conservation. Exploring advanced low-temperature C-H activation catalysts and reaction systems is the key to converting methane in a direct and mild manner.

Recently, a research group led by Prof. DENG Dehui from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences reviewed the latest progress in low-temperature methane conversion in thermocatalytic, electrocatalytic, and photocatalytic systems. The study was published in *Chem*.

"We summarized the typical catalysts employed in various reaction systems, especially the [heterogeneous catalysts](#) with noteworthy C-H activation performance," said Prof. DENG.

"The viewpoints on the [catalyst](#) design, theoretical simulations, choice of reaction conditions, and method of reaction product analysis were introduced to encourage more viable technology for low-temperature methane conversion in the future," said Prof. DENG.

The researchers also pointed out the importance of coupling multiple driving forces from thermal, electrical and [solar energy](#) to jointly activate methane by integrating the advantages of these activation pathways in one reaction system.

Prof. DENG's group has been focusing on the development of 2-D material-based catalysts and their applications in the catalytic conversion of energy-related molecules (*Nature Nanotechnology*, 2016, 11, 218-230; *Chemical Reviews*, 2019, 119, 1806-1854).

As early as 2015, Prof. DENG and Prof. BAO Xinghe, et al. reported the capability of graphene-confined single iron sites for the catalytic oxidation of complicated hydrocarbons at [room temperature](#) (*Science Advances*, 2015, 1, e1500462).

Notable recent progress by the group includes the finding that graphene-confined single iron atoms could even catalyze methane conversion at room temperature (*Chem*, 2018, 4, 1902-1910).

These results demonstrate bright prospects for 2-D-based catalysts in the application of C-H activation and other useful catalytic processes.

Provided by Chinese Academy of Sciences

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