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Water gas shift reaction for hydrogen production and carbon dioxide capture: A review

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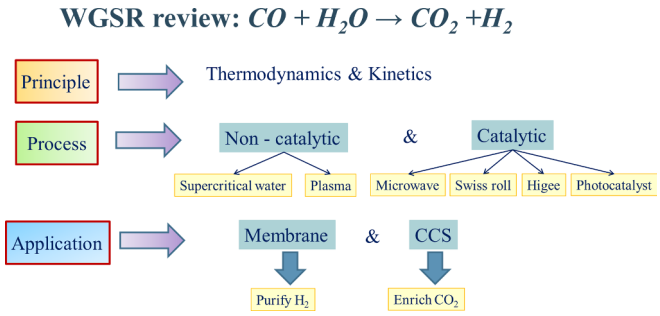
HIGHLIGHTS

- WGSR is an important reaction for H_2 production and CO_2 capture.
- A comprehensive review of the research progress in the WGSR is given.
- State-of-the-art thermodynamic and kinetic characteristics of the WGSR are underlined.
- WGSR behaviors in certain special environments are emphasized.
- WGSR in membrane reactors for carbon capture and H_2 production is addressed.

GRAPHICAL ABSTRACT



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ABSTRACT

The water gas shift reaction is an important and commonly employed reaction in the industry. In the water gas shift reaction, hydrogen is produced from water or steam while carbon monoxide is converted into carbon dioxide. Over the years, on account of the progress in hydrogen energy and carbon capture and storage for developing alternative fuels and mitigating the atmospheric greenhouse effect, the water gas shift reaction has become a crucial route to simultaneously reach the requirements of hydrogen production and carbon dioxide enrichment, thereby enhancing CO_2 capture. This article provides a comprehensive review of the research progress in the water gas shift reaction, with particular attention paid to the thermodynamic and kinetic characteristics. The performance of the water gas shift reaction highly depends on the adopted catalysts whose progress in recent years is extensively reviewed. The behaviors of the water gas shift reaction in special environments are also illustrated, several cases have the ability to proceed with water gas shift reaction without any catalyst. The utilization of several separation technologies on the water gas shift reaction such as carbon capture and storage and membrane reactors for purifying hydrogen and enriching carbon dioxide will be addressed as well. Reviewing past studies suggests that separating hydrogen and carbon dioxide in the product gas from the water gas shift reaction can not only increase efficiency but also enhance the usability for further application. The CO conversion is beyond the thermodynamic limitation after applying membrane for the water gas shift reaction.

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