Introducing Carbon Capture Science & Technology (CCST)!

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Editorial

Introducing *Carbon Capture Science & Technology (CCST)*!

The severity of global warming and climate changes is beyond doubt. Since global warming arises mainly from the emission of CO_2 by human activities, the only solution is to develop carbon capture technologies which allow neutral or even negative CO_2 emissions to be achieved. As a new forefront in the battle against global warming, ***Carbon Capture Science & Technology*** **(CCST)** is a new gold open access journal for researchers working in all areas of carbon capture sciences to disseminate and discuss their latest breakthroughs.

Importantly, carbon capture is a topic much broader than the removal of CO_2 and is concerned with the removal of carbon from any natural and industrial activities that would potentially contribute to the release of CO_2. This is why **CCST** welcomes contributions from engineers, chemists, economists, biologists, environmental and social scientists alike. The inclusive scientific scope of **CCST** is fully reflected in this first issue, which features fourteen papers covering topics that range from the synthesis of novel materials for carbon capture and utilization to the development of new inventory models to control CO_2 emission, but at the same time all contribute significantly to progressing our understandings in carbon capture.

Some of the most exciting research from this issue selected by our editors is highlighted below.

Slotani *et al.* (Masoudi Soltani *et al.*, 2021), from Brunel University London, presented an extensive review on sorbent enhanced steam methane reforming combined with CO_2 capture and hydrogen production. The authors highlighted two key challenges in this research area, including 1) the preparation of catalysts/adsorbents and 2) process synthesis and optimization, and proposed to tackle these challenges by promoting the development of robust AI and machine learning techniques. In addition, this review paper also discussed the challenges in microwave-assisted hydrothermal carbonization (HTC), including the lack of knowledge of microwave heating and information on economic analysis of microwave-assisted HTC.

Biomass-based materials are carbon neutral. Using derived biomass fuels such as biochar can partially replace fossil fuels (e.g. coal) to reduce the emission of CO_2. The preparation and application of hydrochar produced from microwave-assisted HTC were discussed by Zulkornain *et al* in this issue (Zulkornain *et al.*, 2021). In their review, it was concluded that HTC is more cost-effective and energy-efficient than conventional pyrolysis; in addition, microwave heating was suggested to be preferable to conventional heating due to the reduced power consumption and improved energy efficiency.

Two research papers investigating cryogenic CO_2 capture are presented in this ***CCST*** issue. Li *et al.*(Li *et al.*, 2021) from Tsinghua University reported the removal of CO_2 from integrated gasification combined cycle (IGCC) using cryogenic distillation. A high CO_2 purity (99.94%) was achieved from the process meeting CO_2 transportation and storage requirements. The authors showed that the cryogenic CO_2 capture technology has advantages over conventional sorbent-based CO_2 capture, owing to the simplicity of the process and its ability to remove H_2S from IGCC syngas. A moving packed bed was investigated for cryogenic CO_2 capture, focusing on comparing two bed materials and the combination of precooling step and capture step (Cann *et al.*, 2021). The results show that introducing cooling gas to precool bed material could extend the time of CO_2 capture.

A few adsorbents based CO_2 capture technologies are reported, including the use of CaO (Sun *et al.*, 2021; Xu *et al.*, 2021) and potassium-based adsorbents(Guo *et al.*, 2021). In particular, Sun et al.(Sun *et al.*, 2021) proposed a novel concept using CaO-only to achieve both CO_2 capture and utilisation. The excellent efficiency of CO_2 conversion (up to 75%) and 100% CO selectivity were achieved. This result has overcome the thermodynamic limitation of CO_2 hydrogenation to CO in the conventional process, where the molar ratio between H_2 and CO_2 usually is lower than 5. The authors provided a robust and cost-effective material (CaO) for carbon capture and utilisation (CCU), which significantly simplified CCU and has the potential to drive the technology towards commercialization.

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