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Preface to Special Issue

CO_2 Capture, Sequestration, Conversion and Utilization

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This special issue in *Aerosol and Air Quality Research* features selected papers presented at the Symposium on CO_2 Capture, Sequestration, Conversion and Utilization**,** during the 245th American Chemical Society (ACS) National Meeting & Exposition, which was held in New Orleans, Louisiana, USA, from April 7 to 11, 2013. The symposium was organized by Prof. Ying Li at the University of Wisconsin-Milwaukee and Prof. Fanxing Li at North Carolina State University. It was the largest symposium among the twenty symposia within the Division of Energy and Fuels at the 245th ACS National Meeting & Exposition. A total of 80 invited and contributed talks were presented at the symposium. Topics included fundamentals in CO_2 activation and advanced processes and materials for CO_2 capture, sequestration, conversion, and utilization.

Anthropogenic CO_2 emission from fossil energy conversion is one of the major contributors to global climate change. With projected increase in global energy consumption, advanced carbon capture, sequestration, and utilization approaches need to be developed. As a first step for CO_2 mitigation, carbon capture can potentially be achieved, in a cost-effective manner, through new technologies that reduce the energy consumptions for separating diluted CO_2 from conventional power plant flue gas. Alternatively, smart combustion or gasification processes such as oxy-fuel or chemical-looping are capable of producing concentrated CO_2 for easy capture. Successful development and deployment of these aforementioned technologies require breakthroughs in advanced materials as well as innovative reactor concepts and process schemes. Sequestration of captured CO_2 into geological formations such as saline aquifers is the next important step to ensure long term storage of CO_2. Besides sequestration, a number of emerging ideas have shown promise to recycle and utilize CO_2 as a carbon source for clean energy carriers or chemicals, mainly through catalytic processes. While CO_2 is thermodynamically stable, renewable energy sources like solar can accomplish the challenging task of CO_2 conversion and utilization. For example, it has been demonstrated that nanostructured photocatalysts are capable of converting CO_2 and water into C1 fuels like CO, methane or methanol under solar radiation. Extensive research efforts are underway to enhance the CO_2 conversion efficiency using these novel photocatalytic processes.

This AAQR special issue includes ten papers that were selected from the Symposium on CO_2 Capture, Sequestration, Conversion and Utilization. All papers have been peer-reviewed by experts in relevant fields. Among the ten papers, two papers study CO_2 capture by sorbents, and three papers investigate new processes such as chemical-looping combustion and solar thermochemical processes for CO_2 capture. Duan *et al.* conducted an *ab-initio* thermodynamic study of CO_2 capture properties by solid sorbents. Thompson *et al.* investigated the degradation of amine solvents by examining the accumulation of heat stable salts in the solvent in a pilot-scale CO_2 capture experiment. Zhou *et al.* provided a comprehensive overview of chemical-looping combustion for CO_2 capture in fixed-bed and fluidized-bed reactors with the focus on oxygen carrier utilization and reactor efficiency. Cao *et al.* studied lanthanum-promoted Copper-based Oxygen Carriers for Chemical Looping Combustion. Reich *et al.* reported CO_2 capture using calcium oxide looping through a solar thermochemical process and provided a review on the current status of this new technology. One paper in this special issue by Soong *et al.* reports an experimental study of the potential interaction of CO_2/brine/rock on saline formations in a static system under CO_2 sequestration conditions. Three other papers in this special issue report CO_2 conversion to fuels by catalytic processes. Yan *et al.* studied electrocatalytic reduction of CO_2 to methanol in a homogeneous system and found a hydrogen bonded dimer is important for CO_2 activation. Wang *et al.* provided a review on the development of CO_2 photocatalytic reduction technology and compared different CO_2 photoreduction systems. Liu and Li also reviewed the up-to-date research progress on photocatalytic reduction of CO_2 with H_2O, with the focus on TiO_2-based photocatalysts and insights in reaction mechanism. Finally, a review article by Huang and Tan provided an overview of CO_2 utilization including the production of biofuel from microalgae cultivated using captured CO_2, the conversion of CO_2 with hydrogen to chemicals and energy products, and sustainable and clean sources of hydrogen.

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