Rapid and highly effective conversion of biomass and CO_2 into chemicals and fuels under hydrothermal conditions
-A potentially useful technology for speeding up the Earth's carbon cycle

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A serious global energy crisis and the increase in atmospheric CO_2 linked to global warming is the result of an imbalance between the slow formation of fossil fuels and its rapid consumption by human activities. To diminish the imbalance, we can learn from the geologic formation of fossil fuels. The term “hydrothermal” has purely geological origins. A hydrothermal reaction is generally defined as a reaction occurring in the presence of an aqueous solvent at high temperature and pressure. Geochemists have found that hydrothermal reactions, which can be recognised as another pathway in the carbon cycle, played an important role in forming petroleum, natural gas and coal from organic wastes.Thus, if humans could simulate the natural phenomena of the formation of fossils, then, it should quickly turn biomass and CO_2 into fuels and chemicals.

This paper gives an overview of some recent studies of hydrothermal conversion of CO_2 and biomass into value-added chemicals. Biomass conversion mainly involves the conversion of cellulosic and lignocellulosic biomasses into carboxylic acids. For the reduction of CO_2, it is presented that a strategy of highly efficient dissociation of H_2O for the reduction of CO_2 by solar/renewable energy-driven two-step process. Conversion products of CO_2 mainly include formic acid, methane and methanol which are with high yields, e.g., about 70% for formic acid, about 95% for methane and about 30% for methanol, respectively. The proposed hydrothermal reduction of CO_2 is efficient, because the hydrogen derived from water is reacted with CO_2 in situ and high conversions are achieved at mild conditions. Although challenges remain, it is hopeful that the hydrothermal conversion CO_2 will stimulate research on new ways for circulating carbon while producing chemical products.

Fangming Jin received her Ph.D. from Tohoku University (Japan). She was a visiting researcher before she became an assistant professor and then an associate professor at the same university. In 2007, she returned to China and became a professor at Tongji University and a Chair professor sponsored by Chang Jiang Scholar Program (administered by Ministry of Education of the People’s Repubic of China). In 2010, she moved to Tohoku University (Japan) as a professor. From June 2011, she is a distinguished professor at Shanghai Jiao Tong University and is a visiting professor and a fellow of the Graduate School of Environmental Studies at Tohoku University (Japan). Her research centers on the application of hydrothermal reactions for the conversion of biomass and CO_2 into fuels and chemicals. She has authored about 200 scientific publications, patents and book chapters.