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Energy and environment: plasma processes for decarbonization

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It is obvious that our energy resources for the foreseeable future will continue to be based on fossil-derived hydrocarbon fuels. CO2 emissions associated with fossil fuel burning and correlated to global warming trends have many negative consequences across the globe. In the climate challenge to reduce carbon dioxide emissions by decarbonisation, Plasma based techniques are emerging to play a significant role. Coal gasification using steam plasma at ultra-high temperatures (T>1200K) can increase the proportion of lighter hydrocarbons. Methane dissociation to remove the carbon content requires energy input in the form of high-temperature (>1200 ↔C) may benefit from the use of plasma catalysts. Direct conversion of methane to solid carbon using AC plasma torches has been recently successful. Plasmolysis of CO2 to useful products is another very active area of research as many ideas are being pursued. Vibrational excitation is the most effective means for CO2 dissociation because the process requires the least amount of energy. Tailored plasmas to achieve this is a challenge. Another method for CO2 conversion is the partial oxidation reaction which results in the production of hydrogen and solid poly carbon sub-oxide. The concepts of 'Solar Fuels' to produce Carbon neutral energy and the ingenious combination of electricity and gas grids for energy storage may lead to totally carbon neutral fuel systems.

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