



## Plasma Process for Carbon Neutral Chemistry

D. H. Lee, H. Kang, Y. Kim, H. Song, H. Lee, J. Choi, K.-T. Kim, Y.-H Song  
Department of Plasma Engineering, Korea Institute of Machinery and Materials  
e-mail (speaker):dhlee@kimm.re.kr

In the course of plasma generation, energy is distributed among diverse particles such as electron, ion and neutral particles. What is important is the distribution of the energy is not based on the equilibrium based process. Because of this, the process of plasma generation is, in view point of thermal efficiency, is not a good option if the purpose of application is delivery of energy to the target system. And it is also the reason why when trying to initiate and operate a chemical process with plasma, you are always asked about the cost.

In particular, since plasma is usually generated using the electricity, the most expensive energy source, this efficiency problem has been recognized as a limitation of the industrial application of plasma, especially in chemical processes. Recently, plasma-catalysis has been drawing attention as possible option to reduce energy cost of the plasma application, the synergy is on possible kinetics and is not sufficient to reduce the overall cost.

Meanwhile, global warming and carbon dioxide emissions have become global issues and their severity has highlighted, leading to higher demands for restrictions on the use of fossil fuels. These changes are accelerating the shift in the power generation area from fossil fuel-based power generation to renewable energy-based power generation.

On the other hand, the chemical industry is one of the largest carbon dioxide emission sector in industrial area, and carbon dioxide emissions are mostly emitted from the

combustion of fossil fuels in the process of supplying the heat required for chemical processes. And the ever-increasing demand for carbon emission reductions is driving the chemical industry to find ways to reduce the use of fossil fuels. As is easily predictable, a heat source that is not based on combustion is bound to be a realistic alternative to heat supply by an electric heater. Especially supported by renewable electricity.

In the meantime, plasma, despite its low efficiency in terms of energy usage, has been considered to provide the function and advantage of supplying high-energy electrons, ions, and excited neutrals that conventional heaters or reactors cannot provide.

However, the realization of electric power-based energy systems has opened the door to the possibility of using plasma as a heat source. The change in the perspective of using plasma as a heat source can be characterized by 1) that if the starting point of the power is renewable energy rather than fossil fuel, the efficiency of heat generation with plasma will be increased, 2) a temperature condition much higher than that a typical combustion device or electric heater can provide, and 3) the function of high-energy particles can be additionally utilized with the generation of heat.

In this presentation, discuss the function and possibilities of plasma as a heat source in chemical processes will be introduced along with the examples of plasma tentatively being used as a heat source in chemical processes.