World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:17, No:12, 2023

Solar-Plasma Reactors for a Zero-Emission Economy

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Abstract : Recent increase in frequency and severity of climatic impacts throughout the world has put a particular emphasis on the urgency to address the anthropogenic greenhouse gas emissions. The latter, mainly composed of carbon dioxide are responsible for the global warming of planet earth. Despite efforts to transition towards a zero-emission economy, manufacturing industries, electricity generation power plants, and transportation sectors continue to encounter challenges which hinder their progress towards a full decarbonization. The growing energy demand from both developed and under-developed economies exacerbates the situation and as a result, more carbon dioxide is discharged into the atmosphere. This situation imposes a lot of constraints on industries which are involved i.e., manufacturing industries, transportation, and electricity generation which must navigate the stringent environmental regulations in order to remain profitable. Existing solutions such as energy efficiencies, green materials (life cycle analysis), and many more have fallen short to address the problem due to their inadaptation to existing infrastructures, low efficiencies, and prohibitive costs. The proposed technology exploits the synergistic interaction between solar radiation and plasma to boost a direct decomposition of the molecules of carbon dioxide while producing alternative fuels which can be used to sustain on-site high-temperature processes via 100% solar energy harvesting in the form of photons and electricity. The advantages of this technology and its ability to be easily integrated into existing systems make it appealing for the industry which can now afford to fast track on the path towards full decarbonization, thanks to the solar plasma reactor. Despite the promising experimental results which proved the viability of this concept, solar-plasma reactors require further investigations to understand the synergistic interactions between plasma and solar radiation for a potential technology scale-up.

Keywords : solar, non-equilibrium, plasma, reactor, greenhouse-gases, solar-fuels
Conference Title : ICRESGD 2023 : International Conference on Renewable Energy for Sustainable Growth and Development
Conference Location : New York, United States
Conference Dates : December 11-12, 2023