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Plasma Conversion to Electrify Chemical Industry GERARD VAN ROOIJ, DIRK V.D. BEKEROM, NICOLA GATTI, TEOFIL MINEA, SRINATH PONDURI, QIN ONG, WALDO BONGERS, RICHARD V.D. SANDEN, DIFFER — A promising option to mitigate intermittency and to achieve sector integration is plasma synthesis of chemicals and artificial fuels using sustainable energy. This is illustrated on basis of a common microwave reactor approach that is evaluated experimentally with laser Rayleigh and Raman scattering and Fourier transform infrared spectroscopy. For example, 50% energy efficiency was observed in pure CO2 (forming CO and O2) in a thermodynamic equilibrium conversion regime governed by gas temperatures of ˜3500 K. These results are interpreted on basis of Boltzmann solver based plasma dynamics estimates, indicating that intrinsic electron energies are higher than what is favorable for preferential vibrational excitation. Pulsed experiments (1-5 kHz) in which gas temperature dynamics are revealed confirm this picture. In pure N2, vibrational temperatures are observed in excess of 10000K and up to five times higher than the gas temperature. Overpopulation of higher levels is confirmed. These observations are promising in view of economic localized production of fertilizer. An outlook is given to novel reactor approaches that tailor the plasma dynamics to optimally promote vibrational excitation and to achieve the desired non-equilibrium.

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