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Low-temperature upgrading of low-calorific biogas for CO_2 mitigation using DBD-catalyst hybrid reactor TOMOHIRO NOZAKI, HIROYUKI TSUKIJIHARA, WATARU FUKUI, KEN OKAZAKI, Dept of Mechanical & Control Engineering, Tokyo Institute of Technology — Although huge amounts of biogas, which consists of 20-60% of CH_4 in CO_2/N_2, can be obtained from landfills, coal mines, and agricultural residues, most of them are simply flared and wasted: because global warming potential of biogas is 5-15 times as potent as CO_2. Poor combustibility of such biogas makes it difficult to utilize in conventional energy system. The purpose of this project is to promote the profitable recovery of methane from poor biogas via non-thermal plasma technology. We propose low-temperature steam reforming of biogas using DBD generated in catalyst beds. Methane is partially converted into hydrogen, and then fed into internal combustion engines for improved ignition stability as well as efficient operation. Low-temperature steam reforming is beneficial because exhaust gas from an engine can be used to activate catalyst beds. Space velocity (3600-15000 hr-1), reaction temperature (300-650°C), and energy cost (30-150 kJ per mol CH_4) have been investigated with simulated biogas (20-60% CH_4 in mixtures of CO_2/N_2). The DBD enhances reaction rate of CH_4 by a factor of ten at given catalyst temperatures, which is a rate-determining step of methane steam reforming, while species concentration of upgraded biogas was governed by thermodynamic equilibrium in the presence of catalyst.

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