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5th International Conference on
Environmental Toxicology and Ecological Risk Assessment

September 12-13, 2016 Phoenix, USA

An analysis of the effect of argon on methane dry reforming using dielectric barrier discharge

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The use of Dielectric barrier discharge (DBD) plasma is considered as one of the most promising techniques for methane dry reforming (MDR). However, the main downsides of pure DBDMDR are the low reactant conversion, syngas yield and almost severe carbon deposition. Since reactant dilution with argon (Ar) facilitates the plasma generation, the effects of the diluent gas (Ar) on DBDMDR in terms of reactant conversion, product yield, and energy efficiency were studied. The presence of higher Ar content in the reactant mixture led to a higher absolute CH_4 and CO_2 conversions, due to more opportunity for collisions between Ar, neutral CH_4 and CO_2, more contribution of Penning dissociation reactions, and direct electron-molecule/atom impact. However, the intrinsic decrease in converted CO_2 and CH_4 resulting from the decreased concentration of CO_2 and CH_4 in the feed was not compensated. Yield of CO significantly increased from 13.9% to 38.2% whereas that of H_2 from 15.1% to 38%. Introducing Ar into CO_2/CH_4 mixture restrained carbon deposition and assisted in keeping the state of the discharge more stable. Increasing the Ar content from 0% to 80% gave rise to about 56% decline in energy efficiencies of cleavage of both C-H in CH_4 and C=O in CO, which shows the current process is unsuitable for industrial scale-up. Therefore, it might be thought that a DBD plasma reactor will not become as efficient as a conventional thermal reactor for MDR. However, its ease of employment due to its quick start-up and switch-off, its simple implementation, its avoidance of chemical effluent, and its long life processing may still make it advantageous over the conventional thermal MDR. Allowing for the combination of an adequate catalyst with the other kinds of plasma reactors (such as gliding arcs) reported as more efficient alternatives are of essential importance to improve the energy efficiency intending to sustain the economic values.

Biography

Maryam Khoshtinat Nikoo has completed her PhD in 2015 from University Teknologi Malaysia. She was a senior researcher and project manager of Process Engineering and Catalyst Division in R&D Center of Bandar Imam Petrochemical Complex and Catalyst Research Center of Research Institute Petroleum of Iran, before starting her PhD program. She has been journal affairs vice president of IAJC (International Association of journals and conferences, Asia Chapter) from 2008 to 2010 and has been serving as a reviewer for a few prestigious international journals and as an Editorial Board Member of *International Journal of Chemical and Biomedical Science*. She has published quite a number of high impact journal papers, books and conference papers and presentations.

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