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Plasma-catalytic CO_2 hydrogenation over Fe-Cu-based perovskite catalysts

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Abstract (about 150 word with free format)

With the intention of eradicating the serious environmental concern resulting from excessive anthropogenic CO_2 emission, a hybrid dielectric barrier discharge (DBD) plasma-catalysis system was developed for the thermodynamically unfavourable reverse water-gas shift (RWGS) reaction. A variety of $LaMO_3$ (M = Mn, Ni, Fe, Ce, Co) perovskite catalysts were synthesised and assessed. With $LaFeO_3$ exhibiting the best RWGS performance, a series of B-site partial substitution $La_{0.5}Sr_{0.5}Fe_xCu_{1-x}$ (x = 1, 0.9, 0.8) perovskite catalysts were evaluated further. $La_{0.5}Sr_{0.5}Fe_{0.9}Cu_{0.1}O_{3+\delta}$ displayed the greatest potential to promote the selective conversion of CO_2 to CO, and simultaneously inhibiting the generation of CH_4. Its superior catalytic performance should be attributed to the modification on superficial structure: higher metal dispersion, smaller particle size, stronger metal-support interaction, and an electronically richer state of Fe were achieved by the formation of Fe-Cu alloy, which facilitated the adsorption and conversion of CO_2; meanwhile, more oxygen vacancies and higher oxygen mobility were created by the remaining $La_{0.5}Sr_{0.5}FeO_{3+}\delta$ perovskite structure, which promoted the selective conversion of CO_2 to CO. To further investigate the mechanism of plasma-induced surface reactions, a 0D plasma kinetics model was also developed; the results indicate that CHO radicals play a vital role in the plasma-catalytic RWGS process.