Novel Solar-Assisted Method for Mitigation of Methane Emissions via a New Highly Efficient Catalyst

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Global warming poses a pressing challenge marked by rising temperatures and environmental impacts. Methane (CH_4) and carbon dioxide (CO_2) are the main drivers of this phenomenon due to their damage and widespread emissions. Methane, with 80 times more warming potential than CO_2, exacerbates the issue. The current methods of methane mitigation and H_2 production worsen the problem by converting CH_4 to CO_2, adding +500Mt of CO_2 annually. Underscoring the urgent need for technological expansion to mitigate CH_4 & CO_2 emissions. This study introduces an innovative solar-assisted system targeting the most abundant greenhouse gases, CH_4 & CO_2, directly from point sources, converting them into valuable products: H_2 & CO (syngas). By integrating a novel trimetallic catalyst Ni-Cu-Co/Mg(Al)O into a modified solar reactor, operating at 400-600°C, reducing reliance on external non-renewable energy sources and offering an eco-friendly solution. Characterization of the synthesized catalyst using XRD, BET, TEM, and EDX techniques reveals promising features: higher surface area, small particle size (4-7nm), and uniform active site distribution. Performance evaluation through dry reforming of methane tests under CH_4 source conditions demonstrates remarkable efficiencies of 75%, and 90% in CH_4 & CO_2 conversions at 700°C, and 800°C, respectively, with excellent stability, showcasing the success of solar-assisted CH_4 and CO_2 reduction. Furthermore, the system yields impressive H_2 rates of 72%, and 86%, holding significant promise for applications such as coal mines, landfills, and industrial syngas production. This approach not only reduces pollution but also promotes efficient H_2 production, aligning with the United Nations' goal of limiting global temperature for a more sustainable planet