OFFICIAL ABSTRACT and CERTIFICATION

Optimizing the Adsorption Operating Conditions for Dual Functional Materials in Direct Capture of CO2 from Air

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A study of Dual Functional Material (DFM) composed of 0.5% Ru/ 6.1% NaO supported on y- Al2O3 for the adsorption of CO2 and conversion to fuel, CH4, is presented. This process operates at 320 oC for both of the steps, utilizing H2 from an excess renewable energy source to hydrogenate the adsorbed CO2. Previous research with DFM has been performed with applications for large point-sources of CO2 emissions, such as natural gas power plants, using flue gas (7-10% CO2). In this study, DFM was tested for the first time using air with low CO2 concentrations (0.1% CO2, 20% O2, 80% N2), for applications in Direct Air Capture (DAC) of CO2. Four trials were run (10 mL/min air for 15 minutes; 40 mL/min air for 15 minutes; 10 mL/min air for 30 minutes; 40 mL/min air for 30 minutes) testing the flow rate of CO2-containing air and the length of adsorption in order to maximize the adsorption of CO2. Results demonstrated that DFM can adsorb CO2 from concentrations as low as 0.1%. Furthermore, it has been shown that faster flow rates of air (40 mL/min) and longer adsorption times (30 minutes) (122.41 umol CH4/gcat; $p<0.05$) were more favorable for the production of CH4, and inherently the adsorption of CO2. These results evidence that DFM is a promising candidate for applications in DAC, and suggest further research is needed to optimize the operating conditions of the adsorption step.

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