Carbon dioxide is widely produced in industrial waste streams. Routing these streams through CO₂ conversion reactors may be much cheaper than traditional carbon sequestration methods. Corona discharge in micro reactors offers a low-energy CO₂ utilization method.

**Advantages of Corona Discharge**

Corona discharge is a region of ionized gas that forms around a conductor tip at high voltage. Corona discharge can produce a plasma of CO₂ at ambient temperature and pressure. These ions may recombine in the presence of water to form useful products like methane.

**Mechanism of Reactions**

- **Ionization**
  
  $$e + CO_2 \rightarrow CO + O + e$$
  $$e + H_2O \rightarrow H + OH + e$$

- Ions Recombine to Form Products
  
  $$H + CO \rightarrow CH + O$$
  $$H_2 + CH \rightarrow CH_2 + H$$
  $$H_2 + CH_2 \rightarrow CH_4$$

**Results**

Corona discharge was successfully produced on all three needle points using tungsten needles with a tungsten plate and 1-3 kV applied voltage. The current vs. voltage curve indicates stable corona regime. Electrochemical needle etching is not recommended for larger needles due to high manufacturing time and lack of uniformity.

**Future Work**

- Fix or replace Gas Chromatograph to record and analyze products from the reactor.
- Determine conversion from Gas Chromatograph results.
- Determine power efficiency of the reactor.

**Recommendations**

- A detailed parameter space exploration should be done for corona generation in CO₂. Parameters include gap distance, needle sharpness, voltage, distance between needles, and number of needles.
- Model reactor flow to determine bypass area.

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