A framework toward understanding efficient diurnal CO_2 reduction using Si and GaAs photocathodes

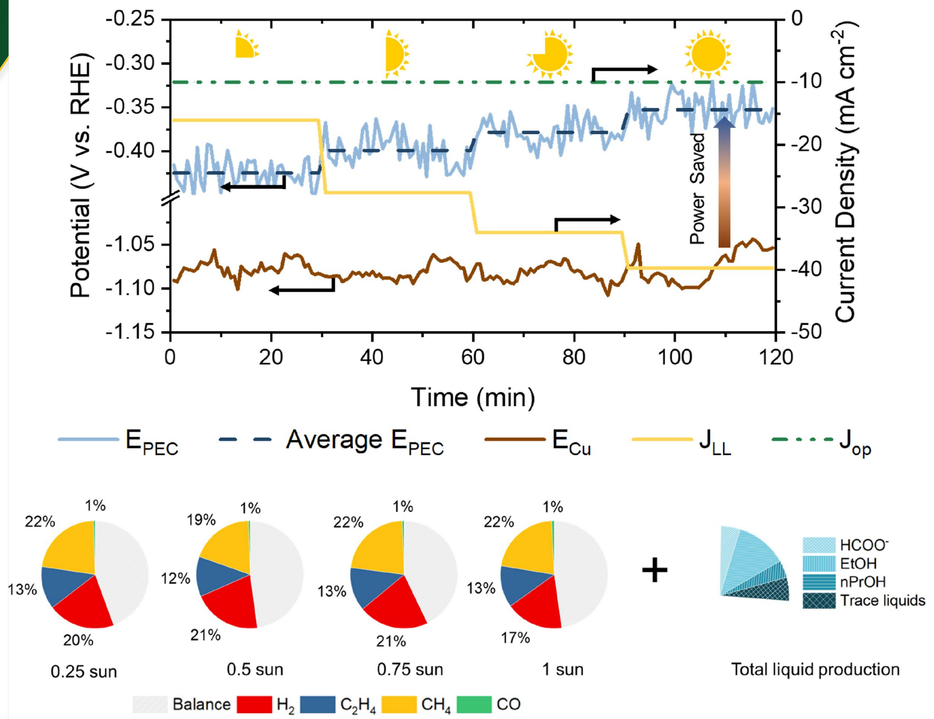

Figure description: Continuous operation of TOPCon Si device under galvanostatic and variable illumination conditions to test PEC CO_2R performance.

Scientific Achievement:

We present Si and GaAs photocathodes for solar-driven CO_2 reduction which demonstrate significant energy savings for CO_2 conversion to C_{2+} products. We probed the effect of variable illumination on the complex product distributions of CO_2 reduction and developed a framework for assessing the performance of solar-driven CO_2 reduction devices under simulated diurnal cycling conditions of solar irradiation to inform future operation of these devices under on-sun environmental conditions.

Significance and Impact:

This work investigates the effect of variable illumination intensity on the performance of solar driven CO_2 reduction devices. We introduce possible operating modes for solar-driven CO_2 reduction and investigate the performance of galvanostatic, assisted, solar-driven CO_2 reduction under variable illumination conditions. This work informs future studies into the operation of assisted and unassisted CO_2 reduction devices under conditions of real-world operation.

Research Details:

- High efficiency TOPCon Si/Cu and GaAs/Cu photocathodes for CO_2 reduction
- Analysis of illumination-driven phenomena for CO_2 reduction
- Framework to assess variable illumination on solar-driven CO_2 reduction
- Modeling of diurnal solar irradiation effects on solar-driven CO_2 reduction

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