



(51) International Patent Classification:

C25B 15/00 (2006.01) **C25B 1/23** (2021.01)
C25B 11/047 (2021.01) **B01D 53/86** (2006.01)
C25B 11/046 (2021.01) **B01D 53/78** (2006.01)
C25B 11/03 (2021.01) **B01D 53/73** (2006.01)
C25B 9/19 (2021.01) **B01D 53/32** (2006.01)
C25B 3/26 (2021.01) **B01D 53/24** (2006.01)
C25B 3/07 (2021.01) **B01D 53/62** (2006.01)
C25B 3/03 (2021.01)

(21) International Application Number:

PCT/US2023/065926

(22) International Filing Date:

19 April 2023 (19.04.2023)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

63/332,644 19 April 2022 (19.04.2022) US

(71) Applicant: **THE BOARD OF TRUSTEES OF THE UNIVERSITY OF ILLINOIS** [US/US]; 352 Henry Administration Building, 506 South Wright Street, Urbana, Illinois 61801 (US).

(72) Inventors: **SINGH, Meenesh**; 352 Henry Administration Building, 506 South Wright Street, Urbana, Illinois 61801 (US). **PRAJAPATI, Aditya**; 352 Henry Administration Building, 506 South Wright Street, Urbana, Illinois 61801 (US). **SARTAPE, Rohan**; 352 Henry Administration Building, 506 South Wright Street, Urbana, Illinois 61801 (US).

(74) Agent: **THOMAS HORSTEMEYER LLP**, Attn.: Ragan BUCKLEY, 3200 Windy Hill Road SE, Suite 1600E, Atlanta, Georgia 30339 (US).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,

(54) Title: INTEGRATED SYSTEM(S) AND METHODS FOR CONTINUOUS ELECTROCHEMICAL CAPTURE AND REDUCTION OF CO₂ FROM DILUTE SOURCES

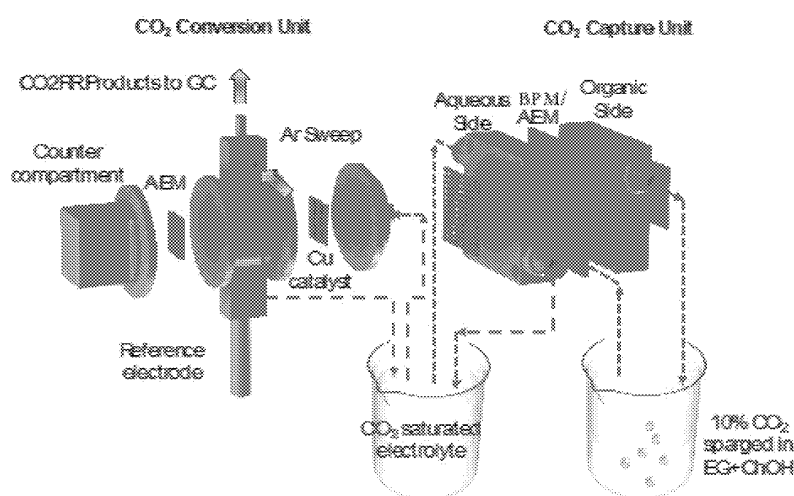


FIG. 1C

(57) Abstract: In one aspect, the disclosure relates to a composition and a catalyst for substantially continuous CO₂ capture and reduction from dilute CO₂ sources including flue gas, wherein the flux of CO₂ captured is substantially equal to the flux of CO₂ reduction. The system can comprise integrated CO₂ capture and reduction components. An exemplary system includes a composition of a catalyst and electrolytes. The catalyst can comprise supported or unsupported mesh electrodes that comprise Cu, a Cu-Al alloy, and/or a copper oxide. In one aspect, the system includes one or more membranes separating an anodic side from a cathodic side in the system, where the one or more membranes can be a bipolar membrane, an anion exchange membrane, or both, which can reduce or eliminate Cl₂ production. In exemplary embodiments, the value-added products can be selected from CO, CH₄, C₂H₄, C₂H₅OH, CH₃COOH, CH₃OH, C₃H₆, and/or H₂.

[Continued on next page]

HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

- (84) Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:

28 March 2024 (28.03.2024)