Dioxide Materials

PRODUCT

Dioxide Materials 25 cm² CO_2 Electrolyzer Cell Hardware with MEA

Important Note: Please read through the entire set of instructions before assembling and operating the cell.

1. The cell inlets/outlets are sealed using black rubber rods in the nuts to keep the Sustainion membrane (in the cell) wetted and in good condition during shipping. The membrane can dry out and may not perform properly if the cell inlets/outlets are left open to air for longer than 1 hour.
2. When the cell is not in use, the following steps are recommended:
   - Add a few drops of DI water into each chamber of the cell
   - Seal the cell ports with the black rubber rods provided with the cell
3. The membrane electrode assembly (MEA), consisting of the membrane, anode, and cathode, cannot be reused. If the cell is disassembled or the membrane dries out, the cell will require replacement with a new MEA set.
4. **DO NOT SHORT THE CELL** externally by touching the two flow field plates simultaneously with a metallic tool, screwdriver, metallic table, or other device.

ELECTROLYZER CELL TESTING INSTRUCTIONS

1. Initial set up for DM Alkaline CO_2 Electrolyzer Cell

a) Cell Assembly

See section 3 below. (Skip if you purchase a complete electrolyzer.)

b) System set up (recommended)

Fig. 1 shows the CO_2 electrolyzer system configuration. Typically, the system setup uses a peristaltic pump to circulate a 10mM $KHCO_3$ aqueous solution (from the reservoir) into the anode chamber at flowrate of 15 mL/min. The suggested tubing used is a 1/4" OD, 1/8" ID PTFE tubing. Pure CO_2 from cylinder is humidified with water using a bottle humidifier (sold separately) and then fed to the cathode chamber at a flow rate of about 10 sccm.

c) Fluid Connections

The fluid inlet and outlet ports are located in the center of cell (Fig. 2).

i) **Cathode:** Remove the nuts from compression tubing and remove black rubber rod from the nut, and connect the tubing (PTFE, 1/4"OD) from the CO_2 humidifier to the compression fitting at the top of cathode (stainless steel flow field); connect the another piece of tubing (PTFE, 1/4" OD) to the compression fitting at the bottom of cathode and route it to the catholyte fluid collector. The exit cathode CO gas stream should be routed to a suitable **EXHAUST VENT or FUME HOOD.**
SAFETY PRECAUTIONS: Please note that CO is a poisonous gas, so do not vent or release the CO cathode product gas into lab or working area. In addition, in working with CO, there may be the possibility of toxic metal carbonyl formation, such as nickel or iron carbonyls, especially at high temperatures. So make sure the CO cathode gas product is properly vented to an exhaust vent or operate the cell in a suitable fume hood.

ii) **Anode:** Remove the nuts from the compression fittings and remove the black rubber rod from the nut. Then push the tubing from the pump tubing 1/4" (OD) PTFE through the nuts, turn the nuts with tubing inside onto the compression fitting at the bottom. Connect another tubing (1/4" OD, PTFE) to the compression fitting at the top, and route back the anolyte reservoir. Tighten the nuts only finger tight.

d) Power Connections

Locate the threaded hole for wire connection on top of the cell (smaller **through-hole** 8-32 thread). Then connect the ring terminal with the Phillips round head screw (**#8**). Use this same procedure for both anode and cathode.

2. Cell Testing and Operation

Begin pumping a 10mM $KHCO_3$ aqueous solution from reservoir at a rate of 15 mL/min into the bottom inlet of the anode compartment and feeding CO_2 through a bottle humidifier to the top inlet of the cathode compartment. Connect the anode electrical lead (red) and cathode lead (black) to the positive and negative connections, respectively, on the power supply with electric wires/cables (not included). Set the power supply voltage at 3-3.2V and slowly begin increasing the current to a setting of 5.00 A (current density of 200 mA/cm^2). The cell current will reach the desired 5.00 A in a few min or hours depending on the cell membrane and electrode conditioning. Testing can also be done with potentiostat, but the connections depend on the testing protocol.

3. Membrane and Electrode Replacement

In order to test new membrane and/ or new catalysts, the cell needs to be taken apart. Loosen and remove all the nuts and washers, and remove gaskets from membrane electrode assembly (MEA). Gaskets and O-ring may or may not be reused depending on the deformation or the time of usage. We recommend using slightly bigger anode than cathode. The thickness of gasket should be about 50um thinner than the electrodes. In assembling a new cell, follow this procedure:

a) Position the Anode flow field plate (Titanium anode) upright with flow field facing laterally (**#1**) and threaded holes (#8) on top. #8 is for electrical wire/cables, and #9 is for thermal couple. Attach stainless steel flat washer (**#2**), insulating shoulder washer (**#3**) and insulating tube (**#4**) in that sequence to 10-32 × 1" socket head cap screw (**#5**). Repeat this procedure for all 8 bolt holes.
b) Lay flat (with all bolts pointing up and flow field exposed), place O-ring into groove for O-ring on the anode flow field and gasket for anode (with 5.5cm × 5.5cm square hole),
c) Place the anode (5.4 cm x 5.4 cm) in the square hole (5.5 × 5.5 cm) of the anode gasket. Do not overlap the anode with the gasket
d) Prepare one piece of 7 cm x 7 cm membrane and place the membrane on top of the anode with the anode in the center of the membrane
e) Place the cathode gasket with eight round holes (for screws) and one square hole (for cathode) on top of the membrane, and locate cathode (5cm × 5cm) in the square hole (5.1 cm × 5.1 cm) of the gasket. Do not overlap the cathode with the gasket
f) Place O-ring into O-ring groove on the cathode flow field (you can add several drops of DI water in the O-ring groove to prevent O-ring falling) and then plan the cathode flow field with flow field facing down on top of the assembly. Channels in cathode flow field are in parallel to that in anode flow field.
g) Insert flat washers and nuts (#**2** and #**7**) and tighten the cell diagonally up to 60 in-lb using torque wrench and Allen key.

Note: The **maximum torque** for the shoulder washers is **70 in-lb**, so please do not over-torque the bolts.

4. Fittings Replacement

We do not suggest removing fittings when disconnecting the cell from test station. However, in the case of failure, the old fittings may need to be replaced with new ones. Unscrew the 1/8" NPT compression fitting (#**6**) anticlockwise and remove the fitting (#**6**), and clear any PTFE thread in the holes. Add two or three layers PTFE tape around the 1/8" NPT thread of compression fitting, gently turn the fitting clockwise to match the thread in the hole. Tighten the fitting finger-tight and then tighten one more turn with wrench. Repeat this until you replace all the fittings.

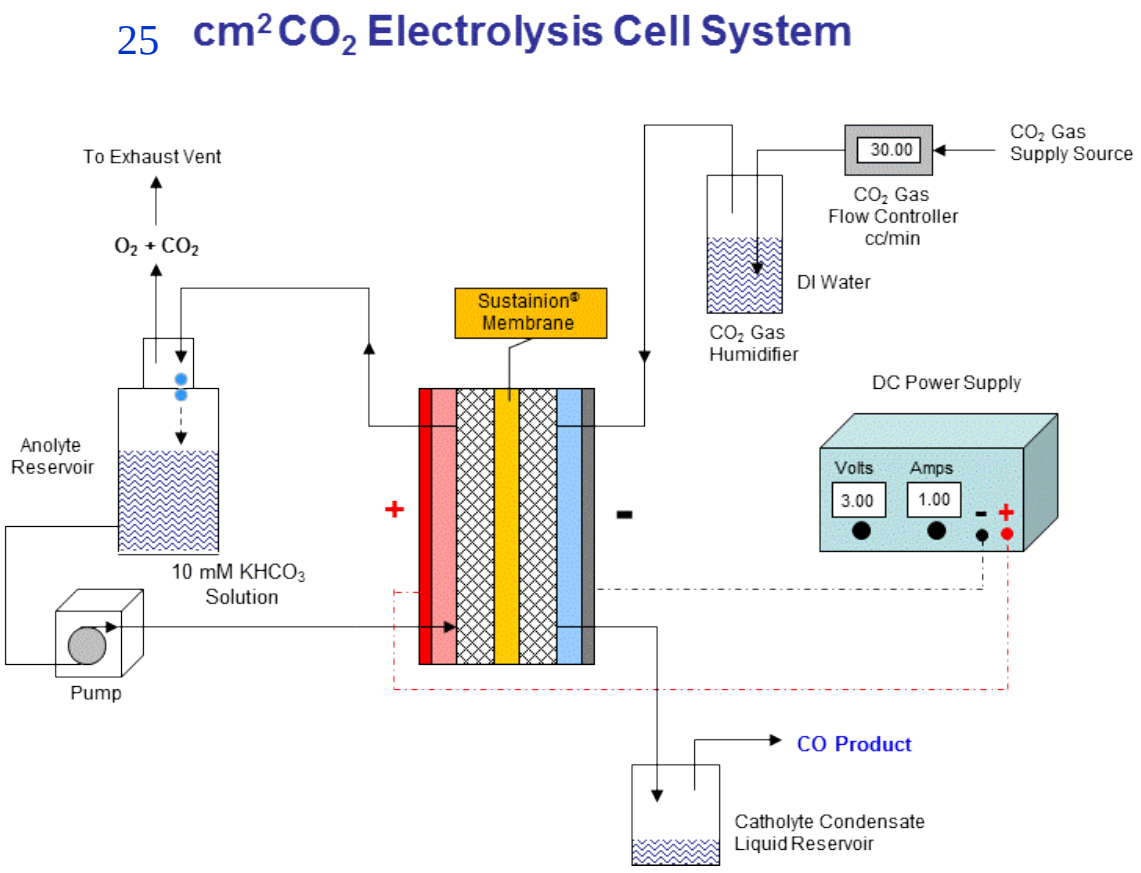
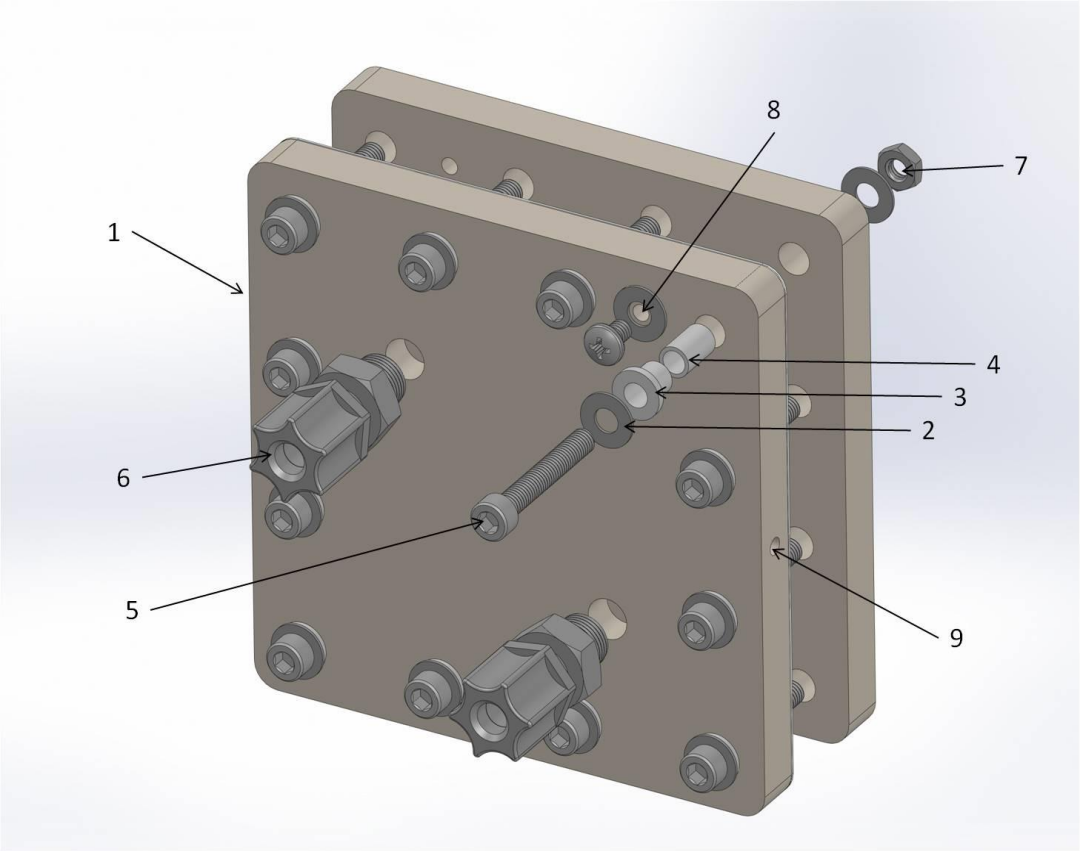


Fig. 1 Recommended alkaline CO_2 electrolyzer operating system configuration.



For further information on the 25 cm² CO_2 Electrolyzer Cell products and spare parts, please contact:

3998 FAU Boulevard Suite 300
Boca Raton, FL 33431-648
Phone: 217 239-1400