Supporting information

Conversion of CO_2 by non-thermal inductively-coupled plasma catalysis

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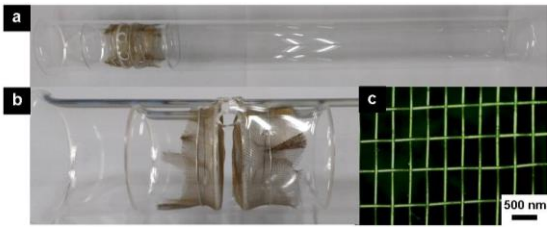

FIG. S1 (a) The catalyst holder, a component developed for our RF-ICP reactor to enable materials to interact fully with CO_2 plasma. Here the material inserted in the catalyst holder are two brass meshes. (b) A zoom-in image of the empty catalyst bed between the two meshes. (c) A microscope image of the dimensions of the brass mesh used for CO_2 splitting.

1. The effect of the RF frequency on CO_2 splitting

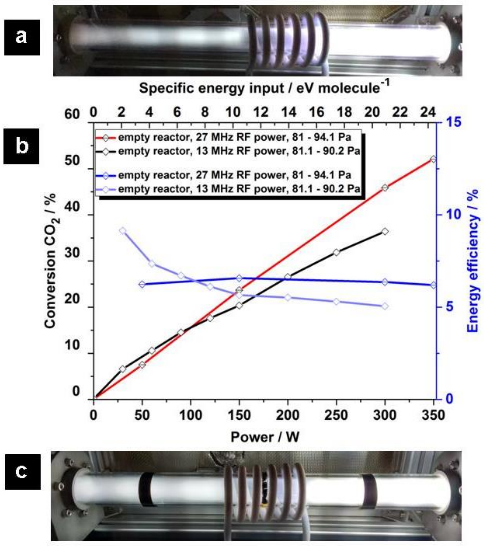

FIG. S2 (a) Image of 200 sccm CO_2 plasma at 300 W with at frequency of 13.56 MHz. The pressure in the RF-ICP reactor is 90.2 Pa and the CO_2 feed gas goes from the left to the right side.

(b) The CO_2 conversion and energy efficiency as function of the input power and SEI (Reaction conditions: 200 sccm CO_2).

(c) Image of 200 sccm CO_2 plasma at 300 W with at frequency of 27.12 MHz. The pressure in the RF-ICP reactor is 92.3 Pa and the CO_2 feed gas goes from the left to the right side.

2. Effect of pretreatment air plasma on reactor wall before CO_2 splitting

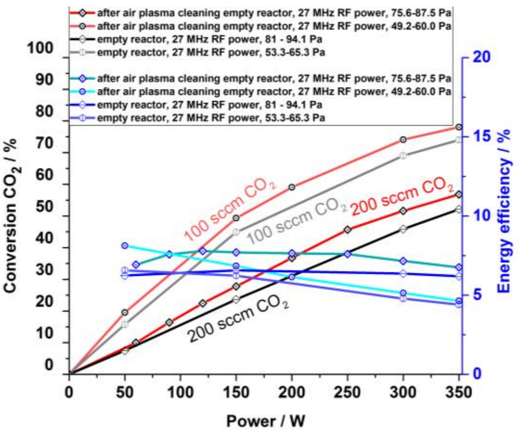

FIG. S3 The CO_2 conversion and energy efficiency as function of the input power. Reaction conditions: black lines display conversion at flow rates 100 and 200 sccm CO_2, the red lines display conversion at flow rate 100 and 200 sccm CO_2 after pretreatment with air plasma (200 sccm air) at 200 W for 45 min and then for 15 min at 300 W.

3. The effect of tuning the CO_2 flow on the CO_2 splitting process

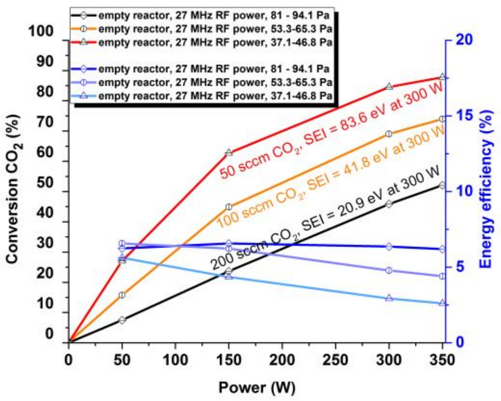

FIG. S4 The CO_2 conversion and energy efficiency as function of the input power. Reaction conditions: black line displays conversion at flow rate 200 sccm CO_2, orange line displays conversion at flow rate 100 sccm CO_2 and red line displays conversion at flow rate 50 sccm CO_2.

4. Effect of multiple brass and stainless steel mesh capsules in the reactor for CO_2 splitting

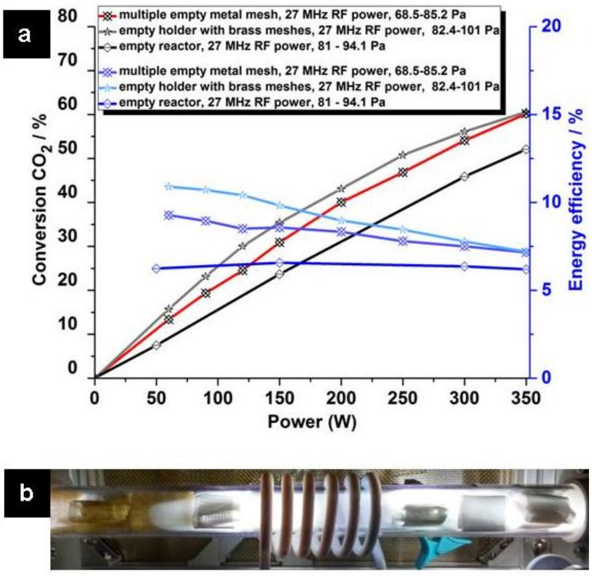

FIG. S5 (a) The CO_2 conversion and energy efficiency as function of the input power. Black line is reference conversion of an empty RF-ICP reactor. Red line is the conversion obtained via multiple stainless steel and brass mesh capsules.
(b). An image of the RF-ICP plasma reactor filled with four stainless steel and three brass mesh capsules exposed to CO_2 plasma (at 250 W and pressure of 79.2 Pa).
Reaction conditions: 200 sccm CO_2 and in FIG. S5b the CO_2 plasma flows from left side to the right side. For the experiment with using multiple metal mesh capsules an additional second vacuum pump (located at the side toward the QMS) is used to lower a bit the starting pressure (with 5 till 7 Pa) before the plasma driven CO_2 splitting is started.

5. XPS analyses of metal meshes before and after plasma driven CO_2 splitting

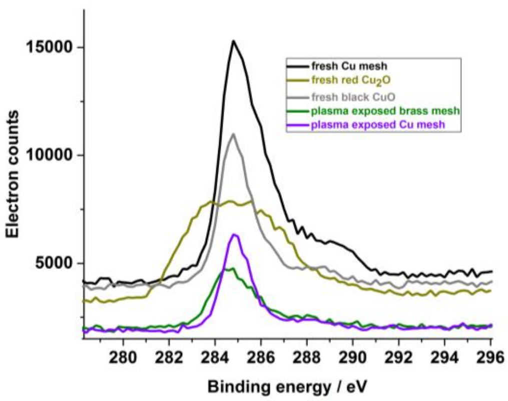

FIG. S6 XPS spectra of carbon about fresh versus plasma exposed metal meshes

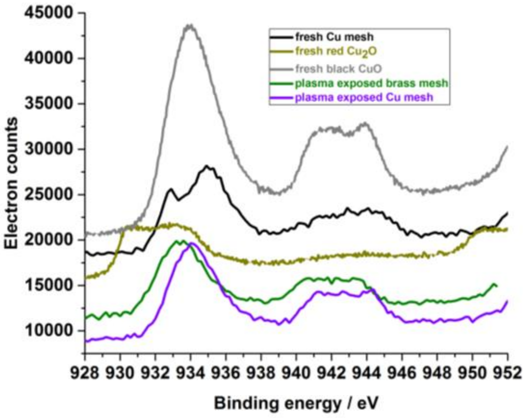

FIG. S7 XPS spectra of cupper about fresh versus plasma exposed metal meshes