Supplementary Information

Radio-frequency heating for Catalytic Propane Dehydrogenation

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Table S1. ICP-MS analysis of MWCNT-COOH

Elements	Concentration (ppm)
Fe	9.25
Ni	1.3
Co	0.88
Pb	3.35

Sulfur levels as reported by the manufacturer was 0.02 wt.%. The concentration of the metals contained in the MWCNTs is four to five orders of magnitude less than that of the Pt in the fabricated catalyst and is highly unlikely to have contributed any significant catalytic activity in comparison.

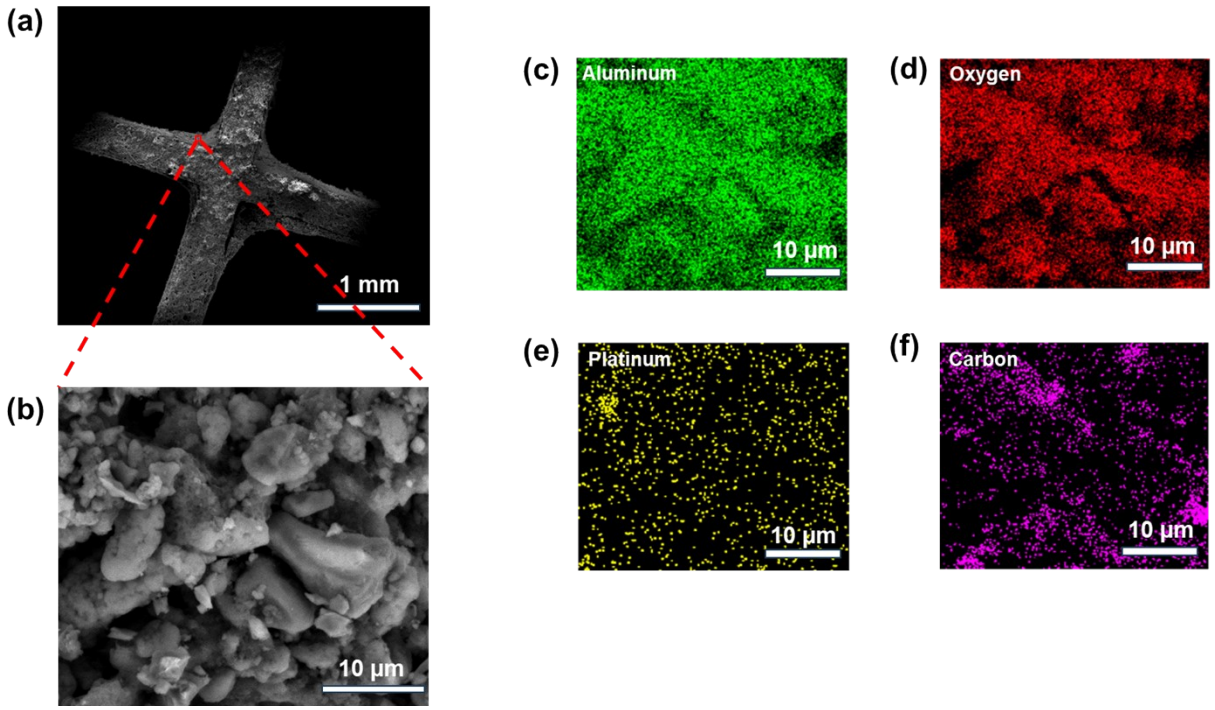

Figure S1. Characterization of the sectioned pre-reaction catalyst-coated monolith (a) Zoomed out SEM image of the catalyst-coated monolith. Scale bar: 1 mm (b) SEM image of the catalyst coating. Scale bar: 10 µm (c-f) EDS mapping (Al, O, Pt, and C) corresponding to SEM image in (a). Scale bars: 10 µm. Elemental weight composition from EDS: O: 38.2 %, Al: 44.7 %, C: 14.3 %, Pt: 2.8 %. Predicted Elemental weight composition: O: 42.55%, Al: 47.84%, Pt: 3.11%, and C: 6.48%.

Section S1.

Scanning Electron Microscopy (SEM) Methods: The morphology of CNT/Alumina/Pt coated monolith was observed with an FEI Quanta 600 field-emission scanning electron microscope. The conducting carbon tape was used to place the catalyst-coated monolith on the sample holder. The acceleration voltage used for imaging was 20 kV.

Energy Dispersive Spectroscopy (EDS) Methods: Elemental composition analysis was performed using an Oxford EDS detector on FEI Quanta 600 SEM, and the results were analyzed using the AZTec software. The brightness of the images was enhanced evenly to improve the visibility.

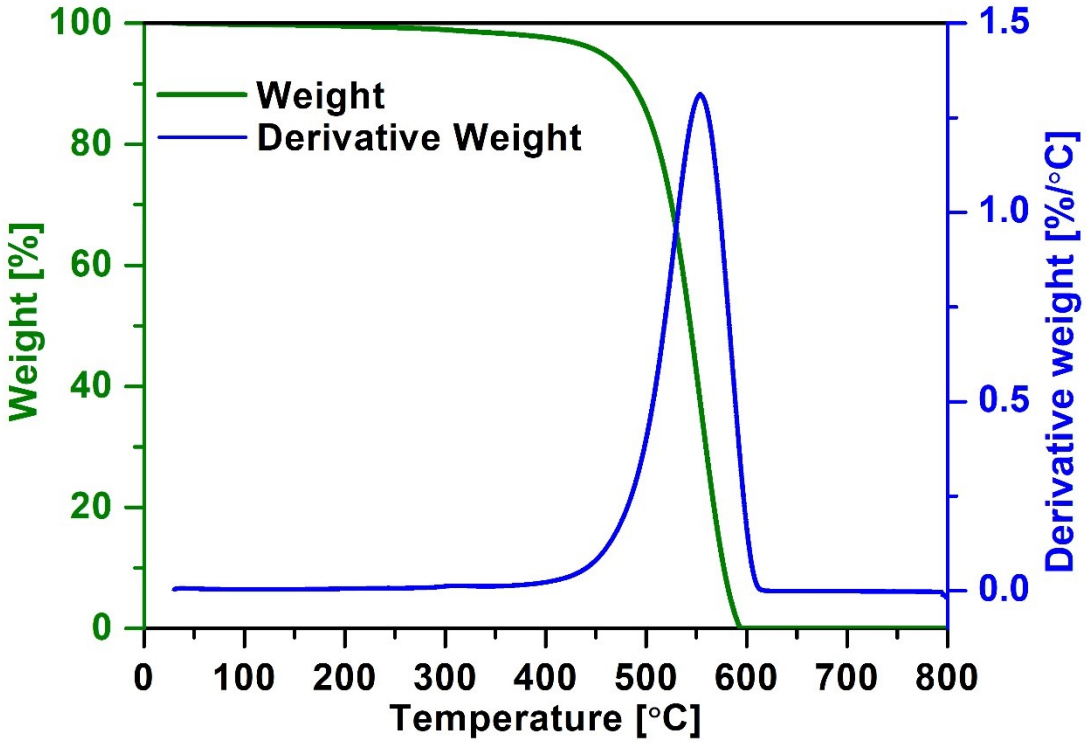

Figure S2. Thermogravimetric analysis (TGA) curve for as-received MWCNT-COOH in air. Operation conditions: 10.41 mg sample, 20 mL/min synthetic air flow, 2 °C/min heating rate.

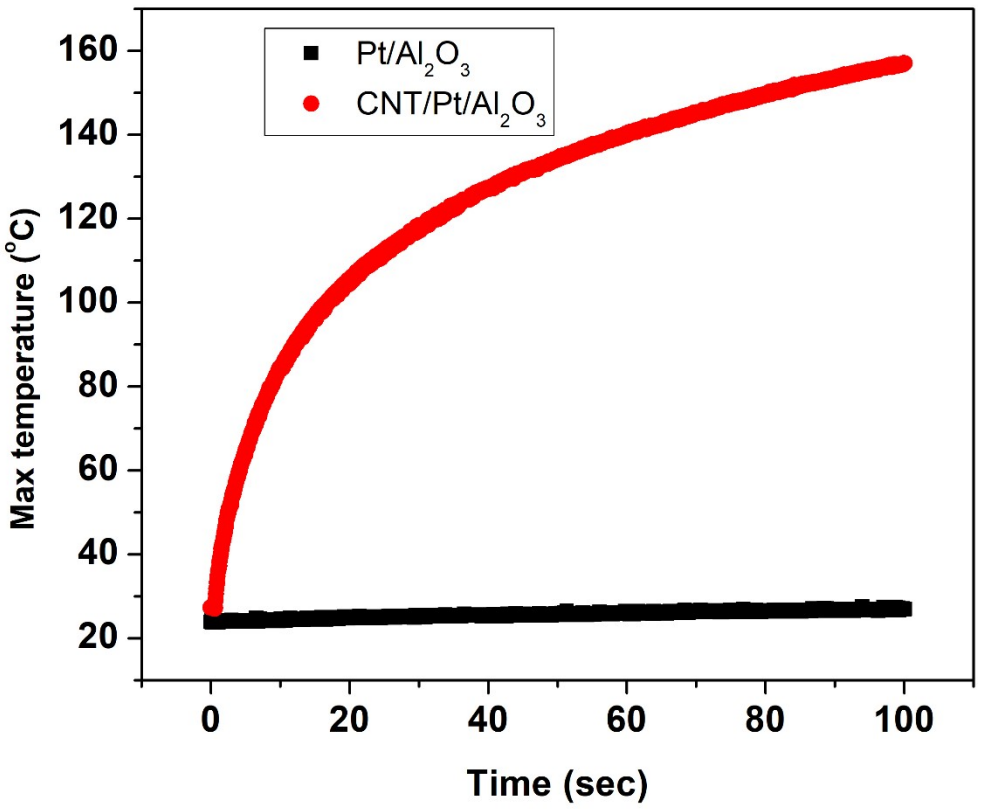

Figure S3. Comparison of heating of Pt/Al_2O_3 catalyst and CNT/Al_2O_3 catalyst in a parallel plate applicator at power of 3 W and frequency of 169 MHz. The temperature is measured using a thermal camera.

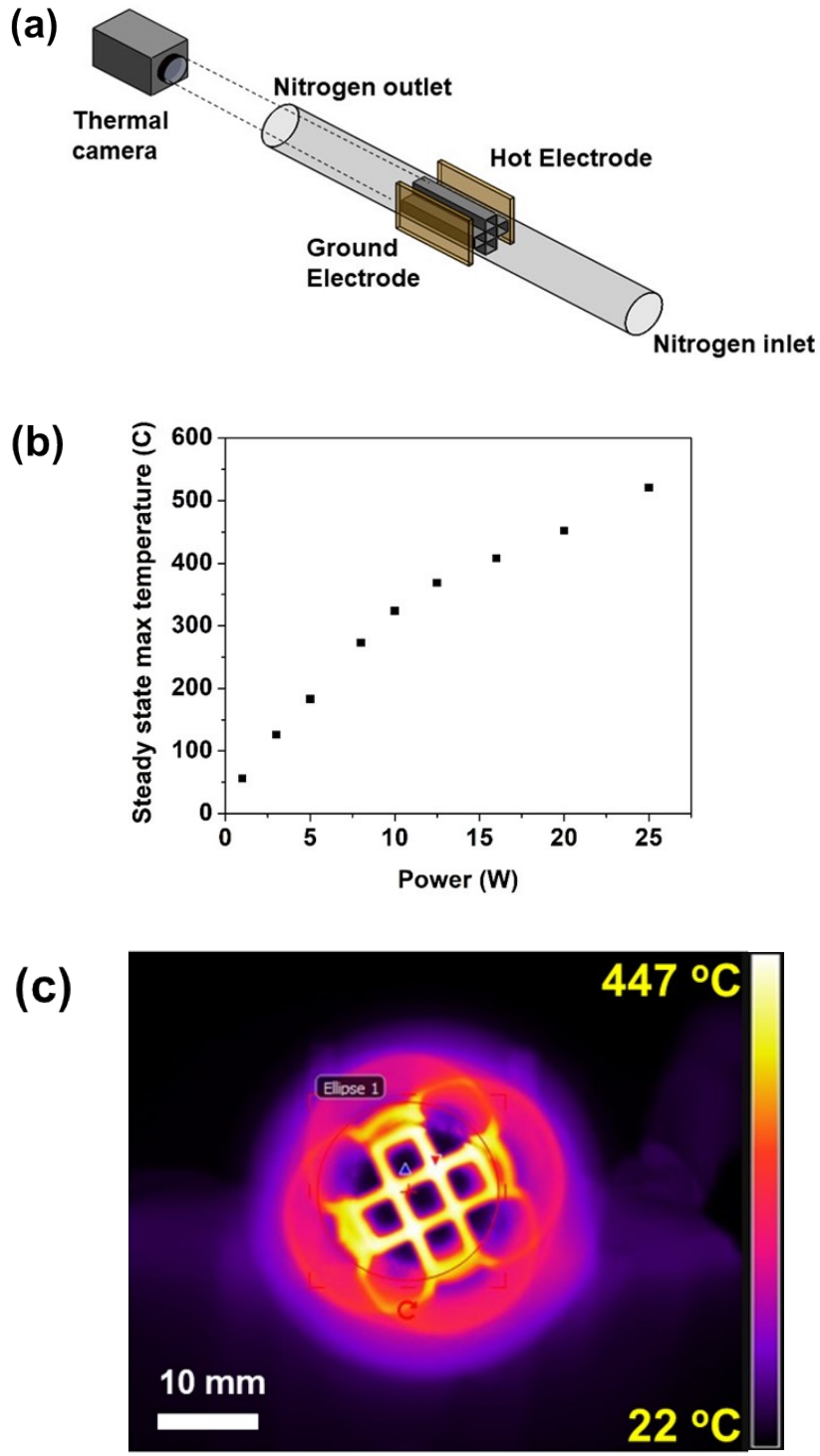

Figure S4. (a) Schematic of RF-heating setup under inert conditions, (b) Steady-state maximum temperature vs. power for parallel plate applicator at a frequency of 192 MHz. (c) Thermal image of the catalyst when heated by RF field at 20 W, 192 MHz using a parallel plate applicator. Resolution = 0.18 mm/pixels (View is down the quartz tube, O.D. = 13 mm).

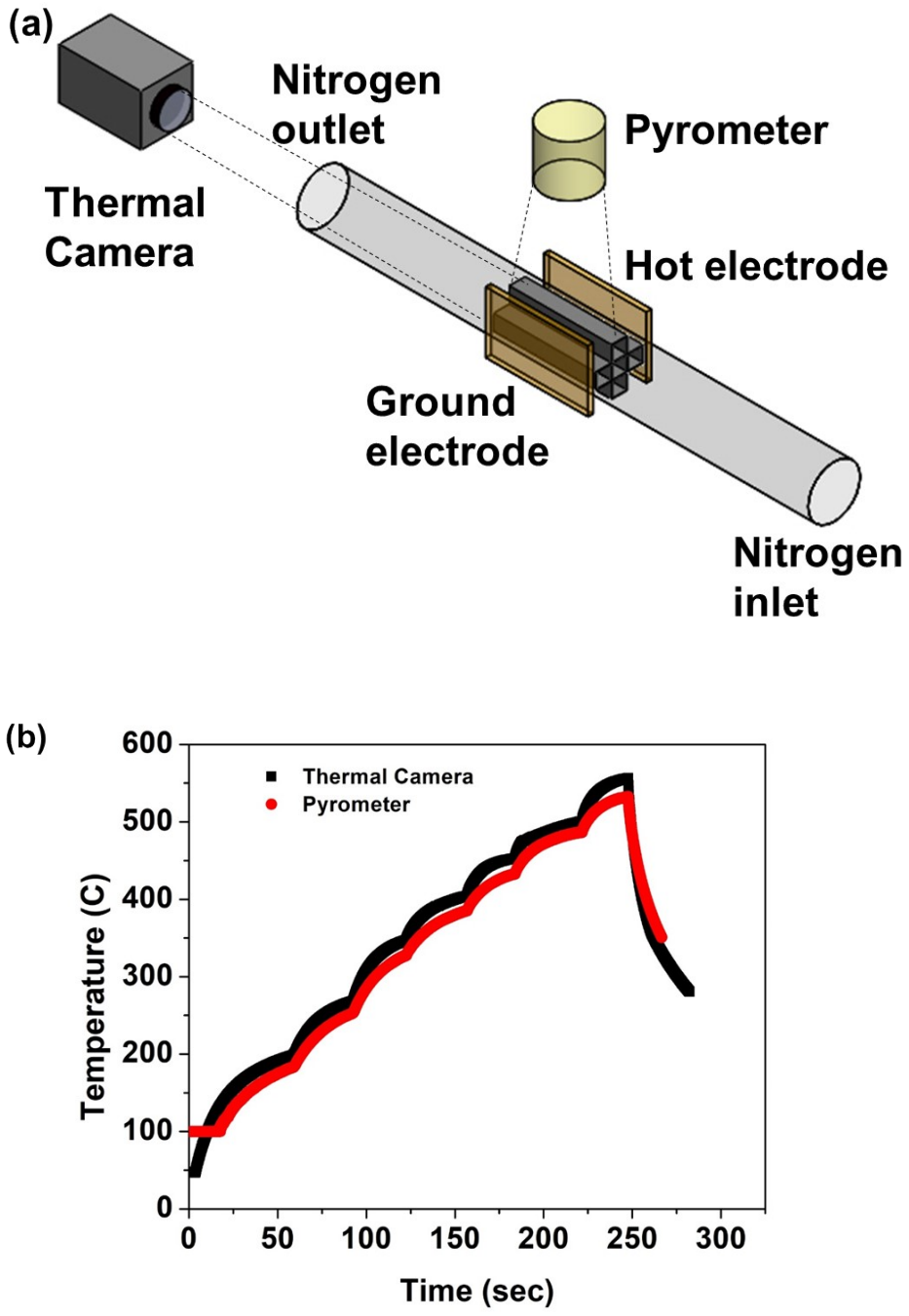

Figure S5. (a) Calibration experiment setup: Thermal camera records the maximum temperature of the cross-section of the catalyst and pyrometer records the temperature of the catalyst (from top) (b) Temperature of the catalyst vs. time when measured using a thermal camera and a pyrometer

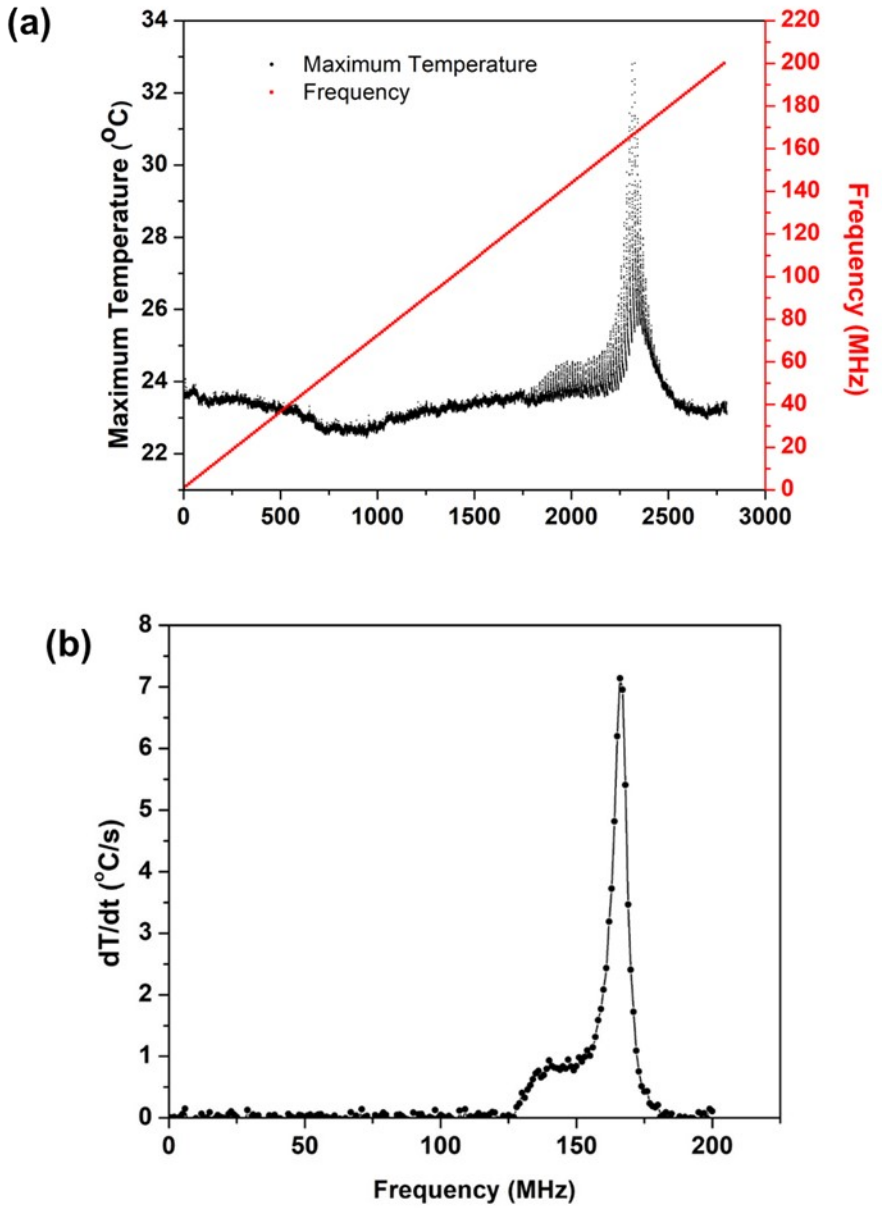

Figure S6. Washcoated cordierite monolith is heated at power of 1 W using a custom radio frequency field applicator while temperature is measured using a thermal camera. (a) Max temperature vs. time during frequency ramp from 1 to 200 MHz; (b) heating rate vs. frequency (computed from data in (a)).

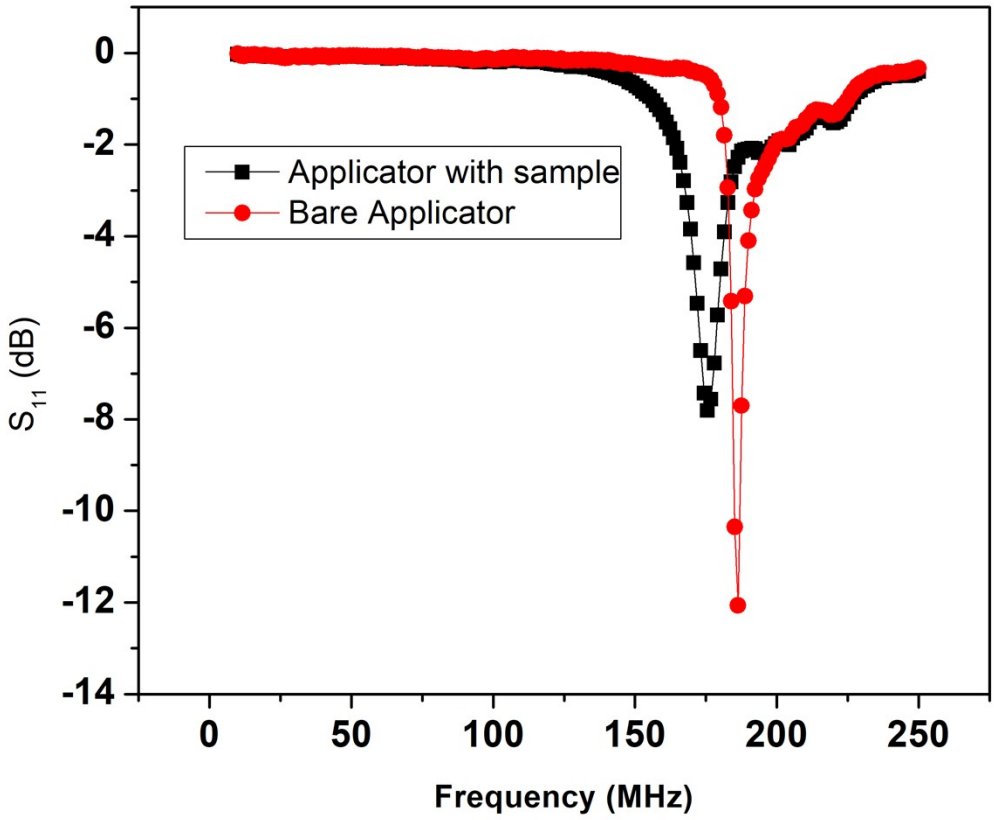

Figure S7. VNA Measurements: S11 is measured as a function of frequency for (a) parallel plate applicator with catalyst, and (b) bare parallel plate applicator.

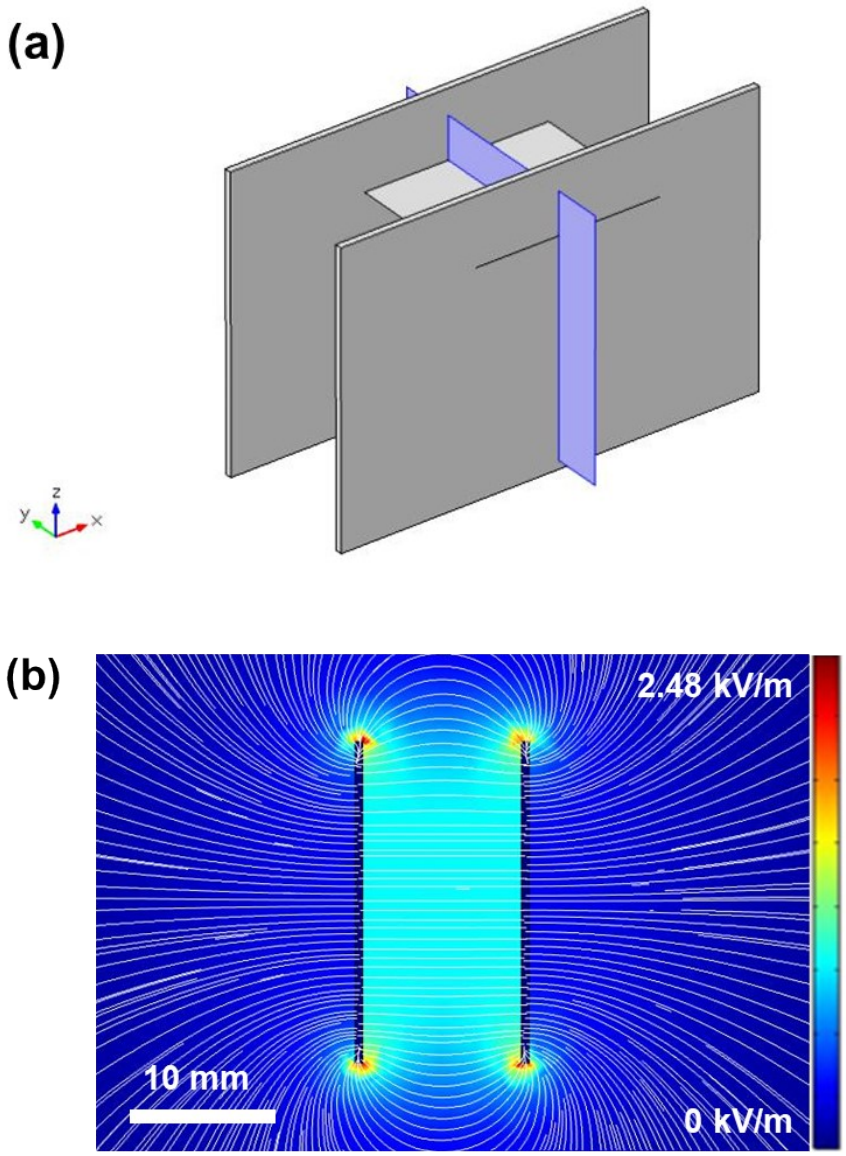

Figure S8. COMSOL simulations of the parallel plate applicator at a power of 30 W and frequency of 200 MHz: (a) The blue plane indicates the plane cut for (b) the electric field norm profile. The color is the electric field norm profile, and white lines indicate the electric field streamlines.

Table S2. COMSOL Simulation parameters used to describe the electric field norm profile in **Figure S8**. The simulation includes surrounding air, lumped port, and parallel plate applicator.

Parameter	**Value**
Input Power	30 W
Input Frequency for Fig. S7	200 MHz
Characteristic Impedance	50 Ohm
Distance between electrodes	0.46 inch

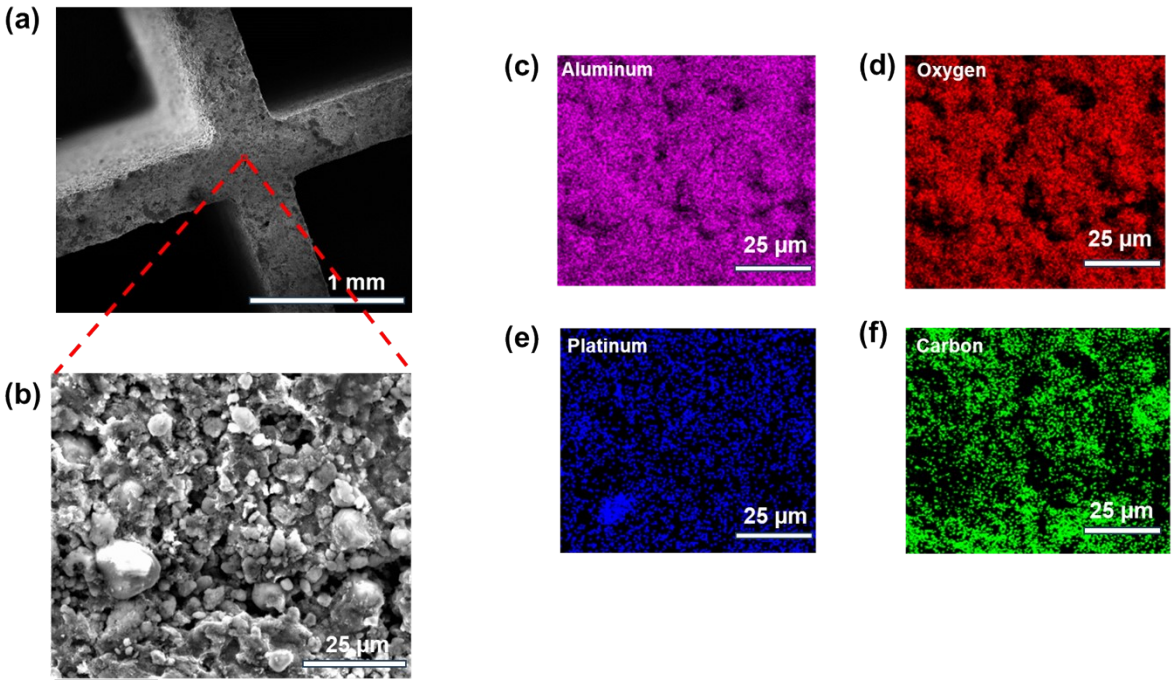

Figure S9. Characterization of the post-reaction catalyst-coated monolith (a) Zoomed out SEM image of the catalyst-coated monolith. Scale bar: 1 mm (b) SEM image of the catalyst coating. Scale bar: 25 µm (c-f) EDS mapping (Al, O, Pt, and C) corresponding to SEM image in (a). Scale bars: 25 µm. Elemental weight composition from EDS: O: 38.2 %, Al: 44.6 %, C: 11.1 %, Pt: 3.5 %.