

## Supplementary Information

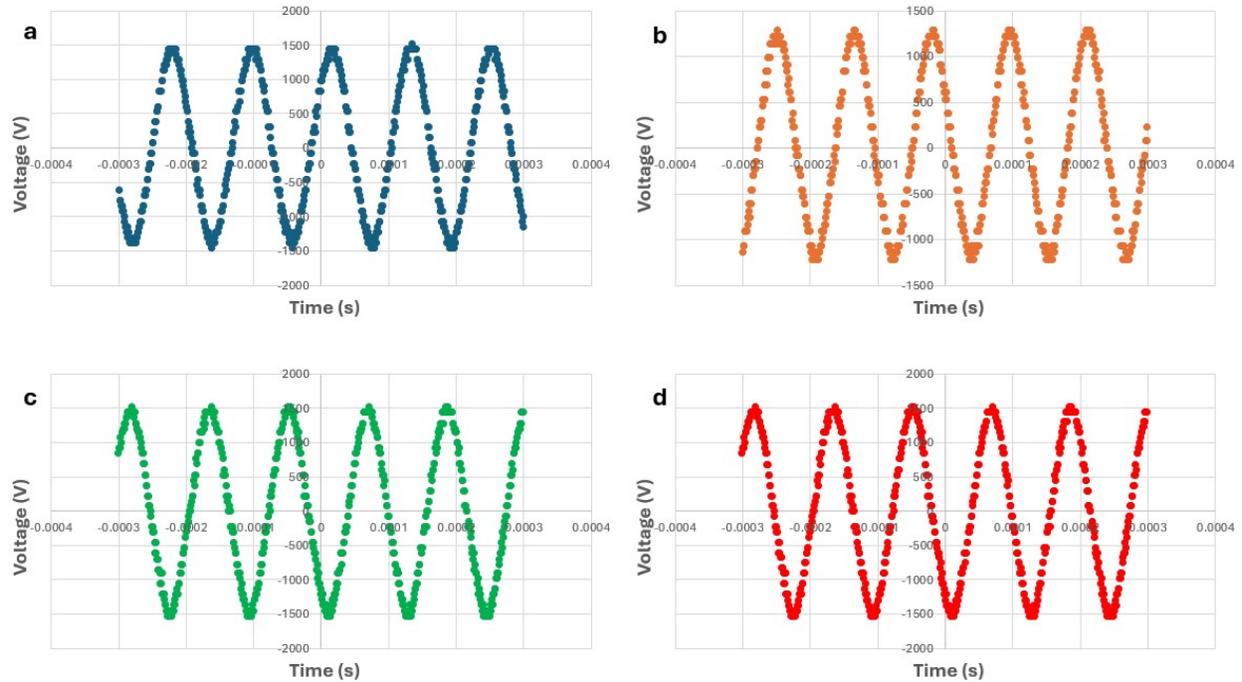
### **DBD plasma-thermal tandem reactors for converting biogas to carbon nanofibers**

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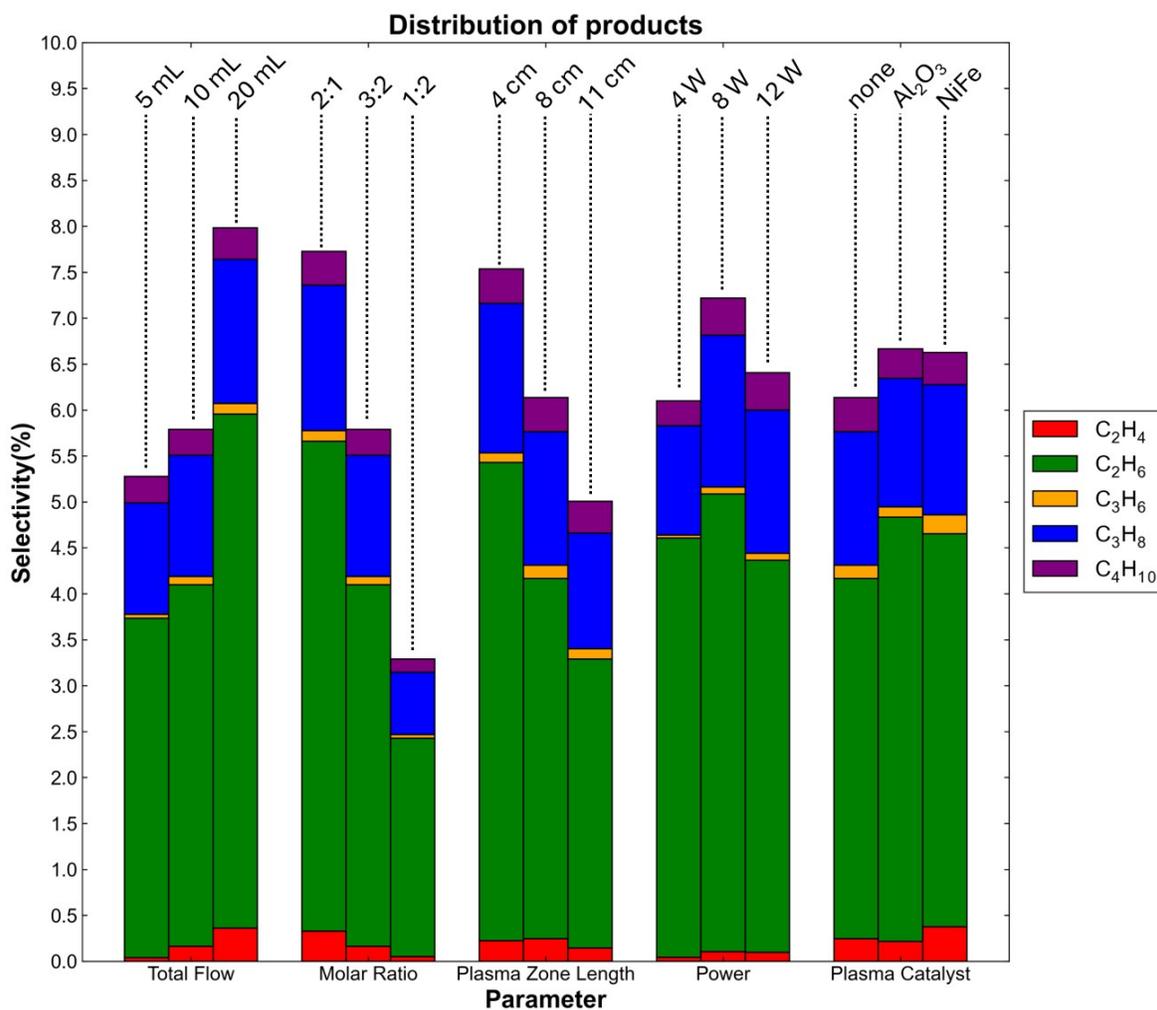
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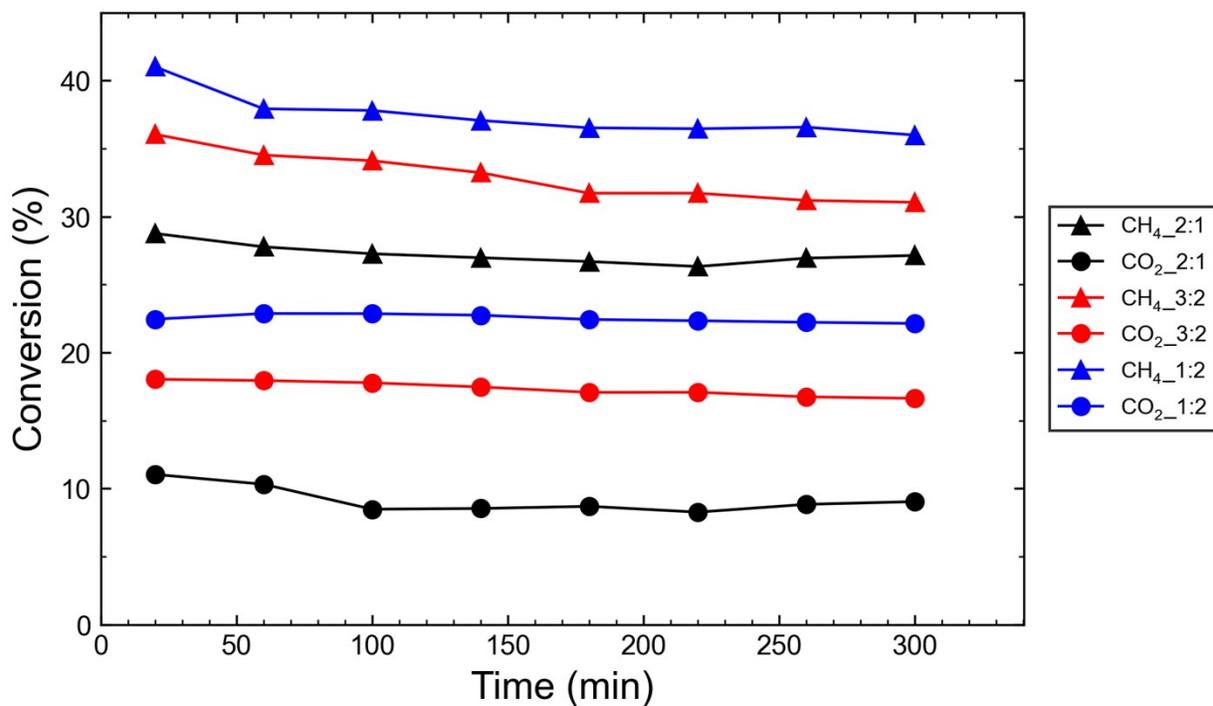
**Figure S1.** Applied voltage versus time measurements for the (a) 4 W, (b) 6 W, (c) 8 W, and (d) 12 W experiments.

**Table S1.** Voltage and current data used to determine the power input for plasma-thermal tandem experiments.

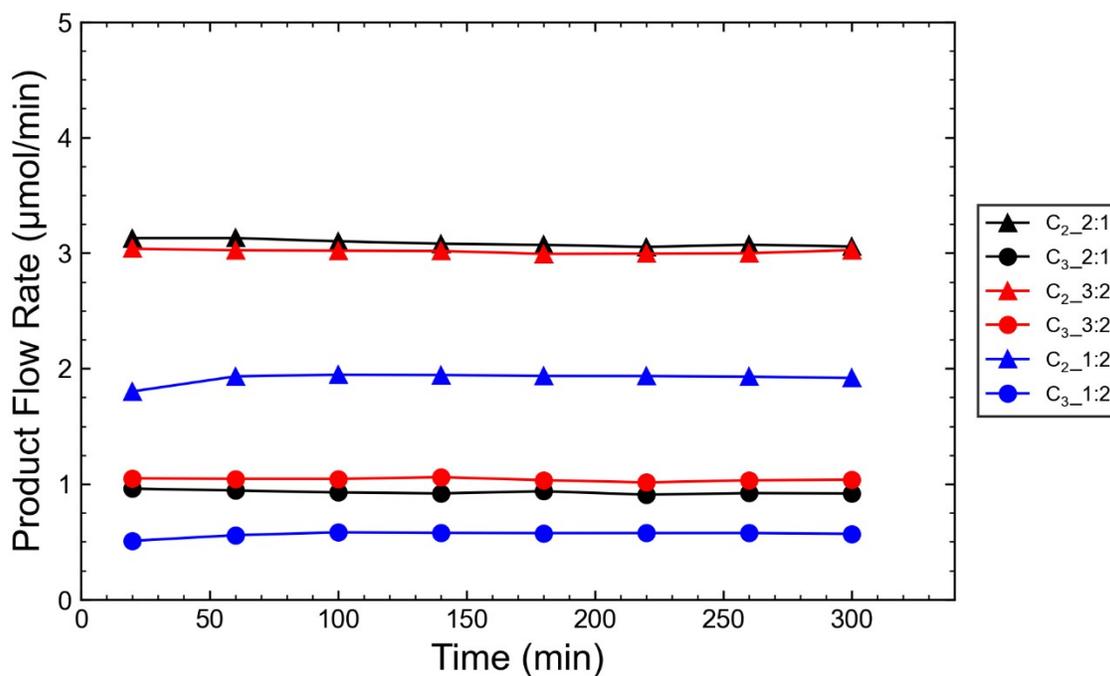
$V_{\max}$ (V)	$V_{\min}$ (V)	$V_{\text{rms}}$ (V)	$V_{\text{res}}$ (V)	$I_{\text{rms}}$ (A)	$P_{\text{rms}}$ (W)
1520.8	-1444.8	1048.5	0.04	0.004	4.2
1292.7	-1216.6	887.2	0.071	0.0071	6.3
1520.8	-1520.8	1075.4	0.076	0.0076	8.2
1748.9	-1672.9	1209.8	0.101	0.0101	12.2



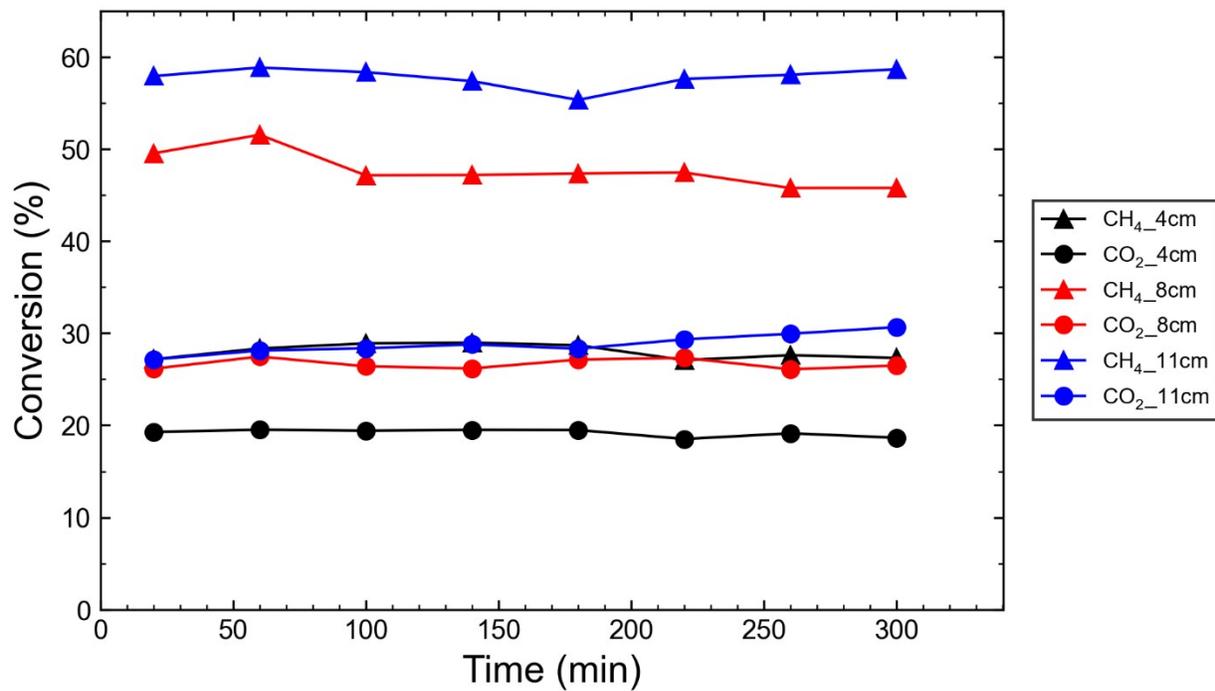
**Figure S2.** Selectivity of gaseous C<sub>2</sub>, C<sub>3</sub>, and C<sub>4</sub> products for all plasma-thermal trials.



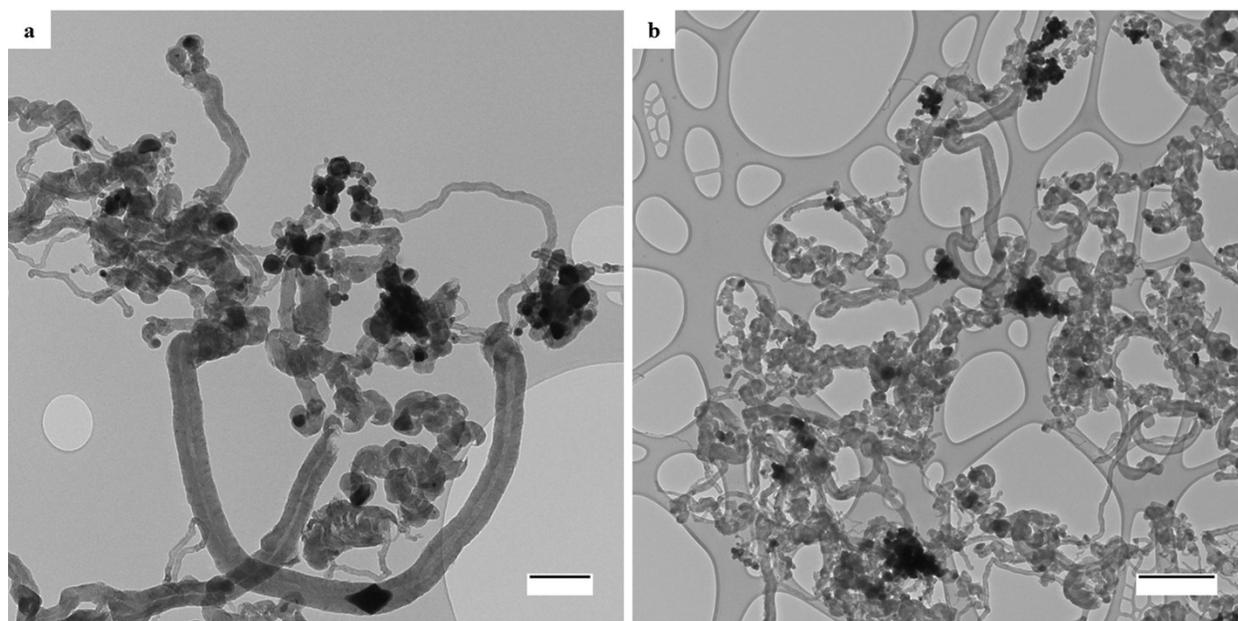
**Figure S3.** Effect of molar feed ratio on CH<sub>4</sub> (▲) and CO<sub>2</sub> (●) conversion. CH<sub>4</sub>:CO<sub>2</sub> molar ratio is specified next to each dataset.



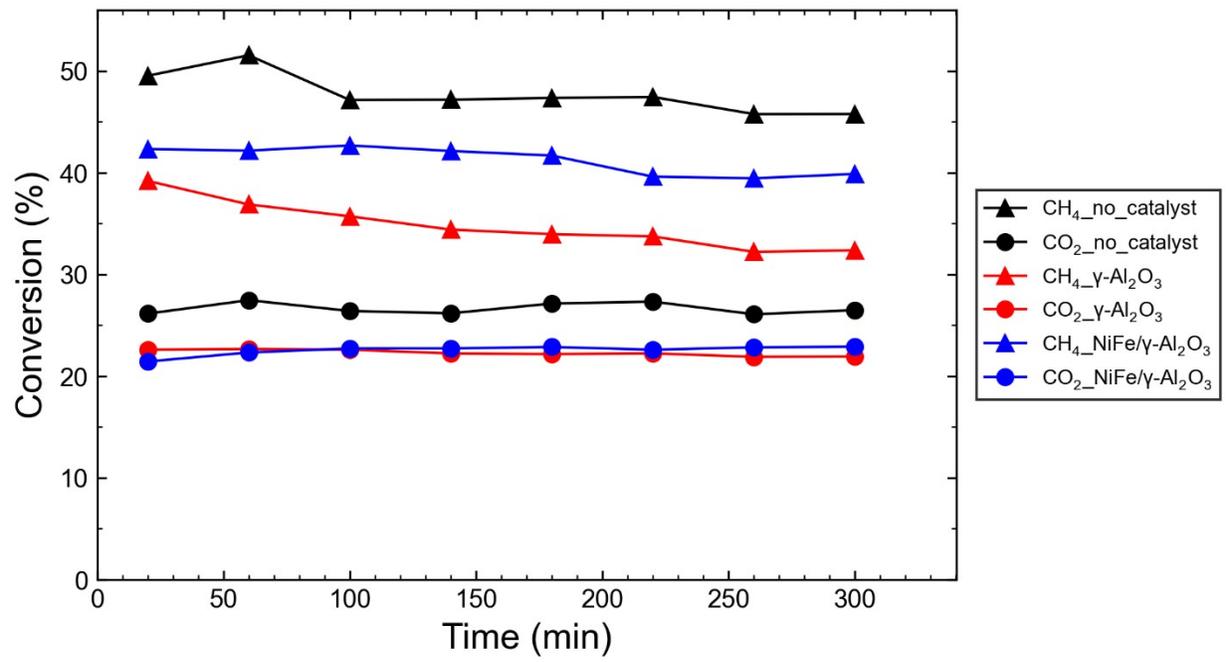
**Figure S4.** Effect of molar feed ratio on C<sub>2</sub> (▲) and C<sub>3</sub> (●) species production. C<sub>2</sub> species includes C<sub>2</sub>H<sub>4</sub> and C<sub>2</sub>H<sub>6</sub> while C<sub>3</sub> species includes C<sub>3</sub>H<sub>6</sub> and C<sub>3</sub>H<sub>8</sub>. CH<sub>4</sub>:CO<sub>2</sub> molar ratio is specified next to each dataset.



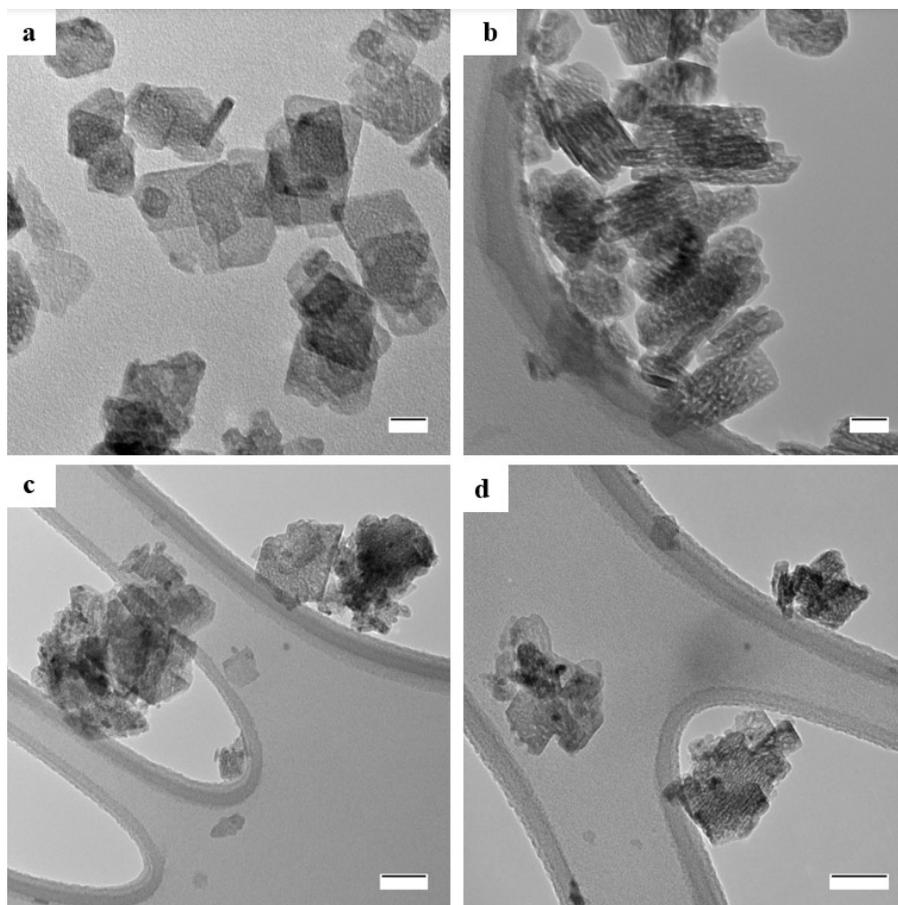
**Figure S5.** Effect of plasma zone length on CH<sub>4</sub> (▲) and CO<sub>2</sub> (●) conversion. Plasma zone length is specified next to each dataset.



**Figure S6.** TEM images of CNF growth on CoK/CeO<sub>2</sub> catalyst using (a) 8 cm and (b) 11 cm plasma zone length. Scale bars are (a) 200 nm and (b) 500 nm.



**Figure S7.** Effect of plasma catalyst on CH<sub>4</sub> (▲) and CO<sub>2</sub> (●) conversion. Plasma catalyst is specified next to each dataset.



**Figure S8.** TEM images of (a) fresh and (b) spent  $\gamma$ - $\text{Al}_2\text{O}_3$  as well as (c) fresh and (d) spent  $\text{Ni}_4\text{Fe}/\text{Al}_2\text{O}_3$ . Scale bars are (a-b) 20 nm and (c-d) 50 nm.