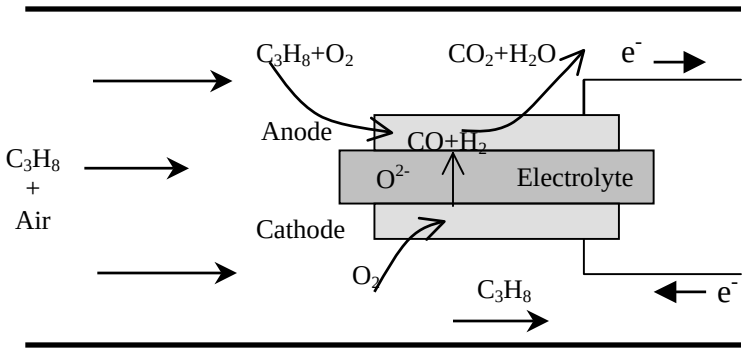

Supplementary Figure.1 Principle of operation of a SCFC under a propane-air mixture. The anode and cathode of the single chamber fuel cell are located in the same chamber and exposed to the same air-propane mixture. The anode is active and selective for propane partial oxidation and for electro-oxidation of the resulting H_2 and CO:

$$C_3H_8 + 3/2O_2 \rightarrow 3CO + 4H_2$$

$$CO + O^{2-} \rightarrow CO_2 + 2e^- \qquad \text{anode}$$

$$H_2 + O_2 \rightarrow H_2O + 2e^-$$

The cathode, in contrast, is active and selective for oxygen electro-reduction:

$$1/2O_2 + 2e^- \rightarrow O^{2-} \qquad \text{cathode}$$

Although exposed to the same gases, the differing catalytic and electrocatalytic activities of the cathode and anode towards propane and oxygen generates an oxygen partial pressure gradient across the fuel cell and hence a voltage, which can then be used for power generation. As a consequence of the exothermic nature of the partial oxidation reaction, the fuel cell temperature can, depending on the experimental conditions, be as much as 245°C higher than that of the furnace nominally used to fix the fuel cell temperature [S6, 1]. Ideal electrodes are active only for the desired reactions and inert to all others. In particular, the ideal cathode does not catalyze propane oxidation.

[1] Hibino, T., Hashimoto, A., Inoue, T., Tokuno, J., Yoshida, S. & Sano, M. A solid oxide fuel cell using an exothermic reaction as the heat source. *J. Electrochem. Soc.* **148**, A544-A549 (2001).