Microwave active conductive metal oxides for CO_2 dry reforming of methane

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Why dry reforming?

$$CH_4 + H_2O \leftrightarrow 3\ H_2 + CO$$
$$CO + H_2O \leftrightarrow H_2 + CO_2$$

Methane steam reforming

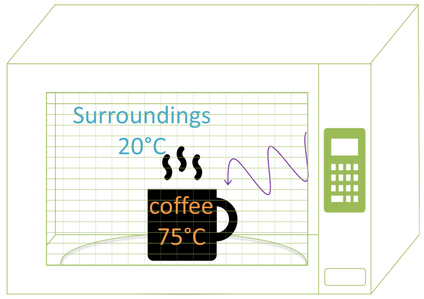
- generates 9 tonnes CO_2 for each tonne of H_2

Dry reforming methane

- consumes CO_2 instead of producing
- generates syngas in a 1:1 ratio
- **Requires higher temperatures**

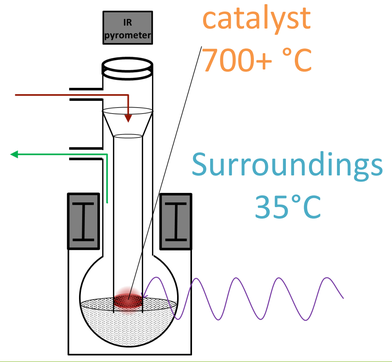
$$CH_4 + CO_2 \leftrightarrow 2\ H_2 + 2\ CO$$

Why microwaves?

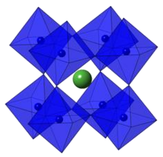


- Microwaves heat selectively
- Saves energy and time by only heating what needs heating

- Chemical reaction occurs at catalyst surface
- Selectively heat where the reaction occurs



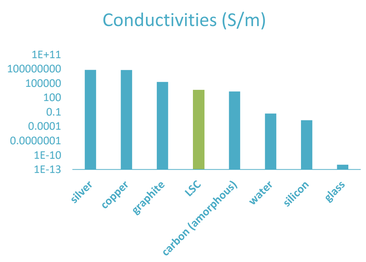
Conductive oxides



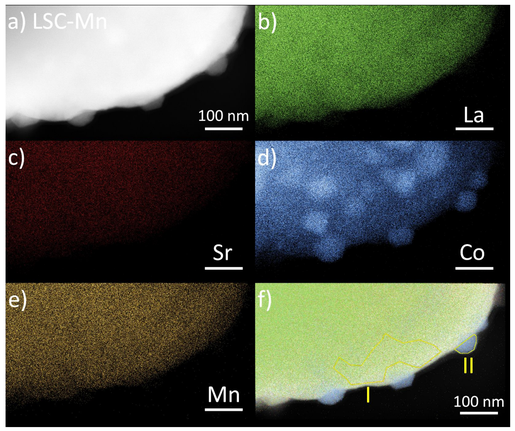
LSC

- Our catalysts are based on the conductive perovskite oxide $La_{0.8}Sr_{0.2}CoO_3$ (LSC)
- As an oxide, LSC can safely be heated in air to remove coke

- High conductivity allows it to heat efficiently in microwave

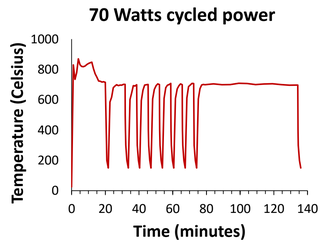


Active site evolution



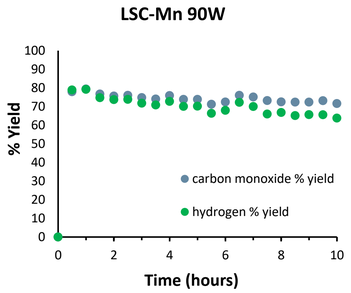
- Under reaction conditions, catalyst partially reduces
- Reduction leads to metal nanoparticles forming

Catalyst Performance



- Microwave heating allows rapid, efficient heating and cooling

- Optimized catalysts give stable performance for ~10 hours
- Heating in air or CO_2 restores to initial conversions



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