

#### **Artificial photosynthesis**

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Solar Fuels Umeå





## Mimicking the photosynthesis



#### PhD project



## Aim

Synthesis of a calcium manganese oxide catalyst for water oxidation using three different methods

- 1. Benzyl alcohol route
- 2. Direct soft template method
- 3. Hard template method

#### 1) Benzyl alcohol route:

- The precursors Ca(No3)2 and Mn(Acac)2 were dissolved in a benzyl alcohol solution.
- After complete dissolution, the mixture was put into a digestion bomb for calcination: 48 hours, 200°C.
- After centrifugation and washing three times the mixture, the compound was dried overnight at 85 °C
- The powder was then calcinated 5 hours at 400 °C

# Methods 2) Direct soft template method:



3) Hard template method:

- The silica template KIT-6 (made from Pluronic-P123 and TEOS (tetraethylorthosilicate)) was used.
- Precursors: MnCl<sub>2</sub> and Ca(NO3)<sub>2</sub>.
- Two impregnations were made on KIT-6.
- Calcination at 200 °C and 450 °C.

Analysis:

Clark electrode for oxygen evolution



Analysis:

- Nitrogen Physisorption (B.E.T.) was used to measure the surface area and the pore volume of the catalysts.
- Transmission Electron Microscopy (TEM) was used to investigate the structure and the morphology of the catalysts.

#### Results



#### Results

#### 3) Hard template method:

BET Surface Area: 34.5131 m<sup>2</sup>/g Adsorption average pore width: 12.11930 nm



#### Results

#### **TEM** pictures



Calcium manganese oxide

#### Conclusions

- The best oxygen evolution was obtained using the hard template method.
- The soft template method was unstable due to the sensitivity to the pH and thus difficult to repeat.
- The benzyl alcohol route results showed a poor activity for the water oxidation.

Thank you!