

A photograph of the University of Florida's iconic tower, known as the 'Gator Tower', set against a clear blue sky. The tower is a tall, brick structure with a distinctive top section featuring arched openings. The image is positioned on the left side of the slide, partially overlapping the dark blue background.

# Solar Thermochemical Fuel Production at the University of Florida

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**FESC Florida Energy Systems Consortium  
(FESC) Workshop**

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# Thermochemical Fuel Production

## Solar Concentration

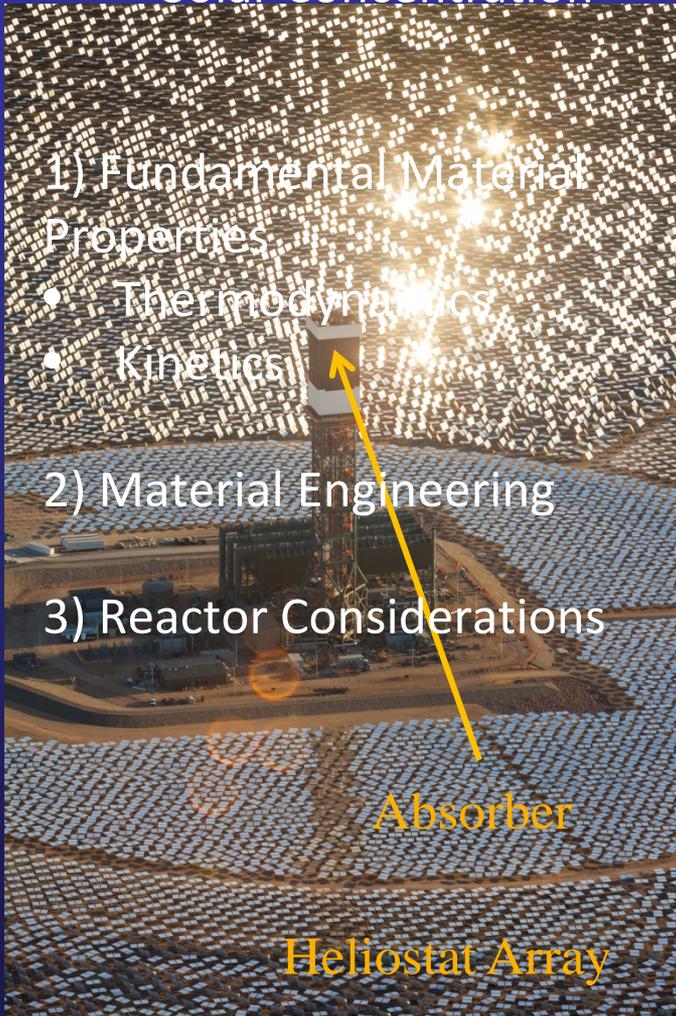
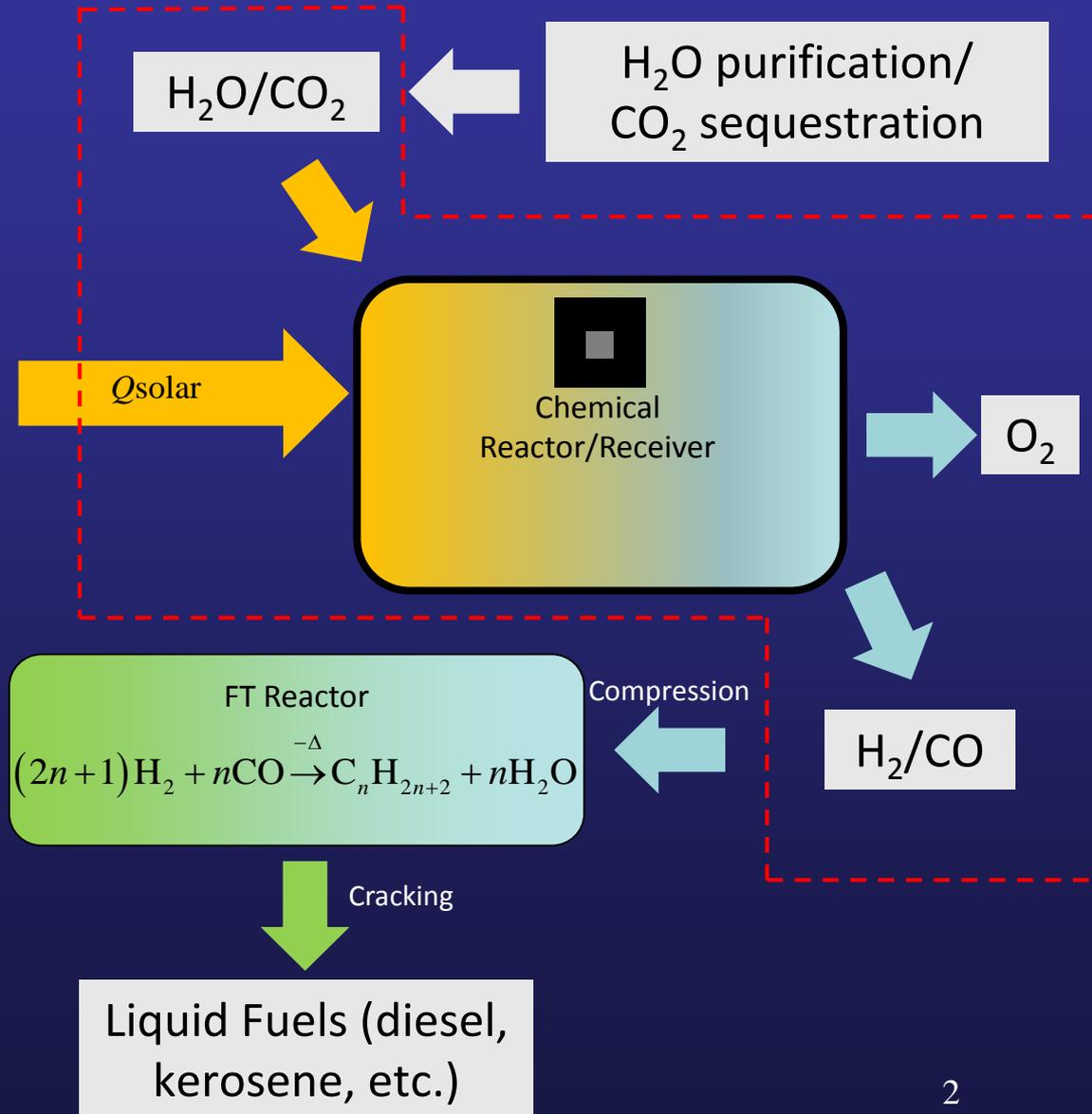


Image: <http://www.brightsourceenergy.com/>

5/27/2015



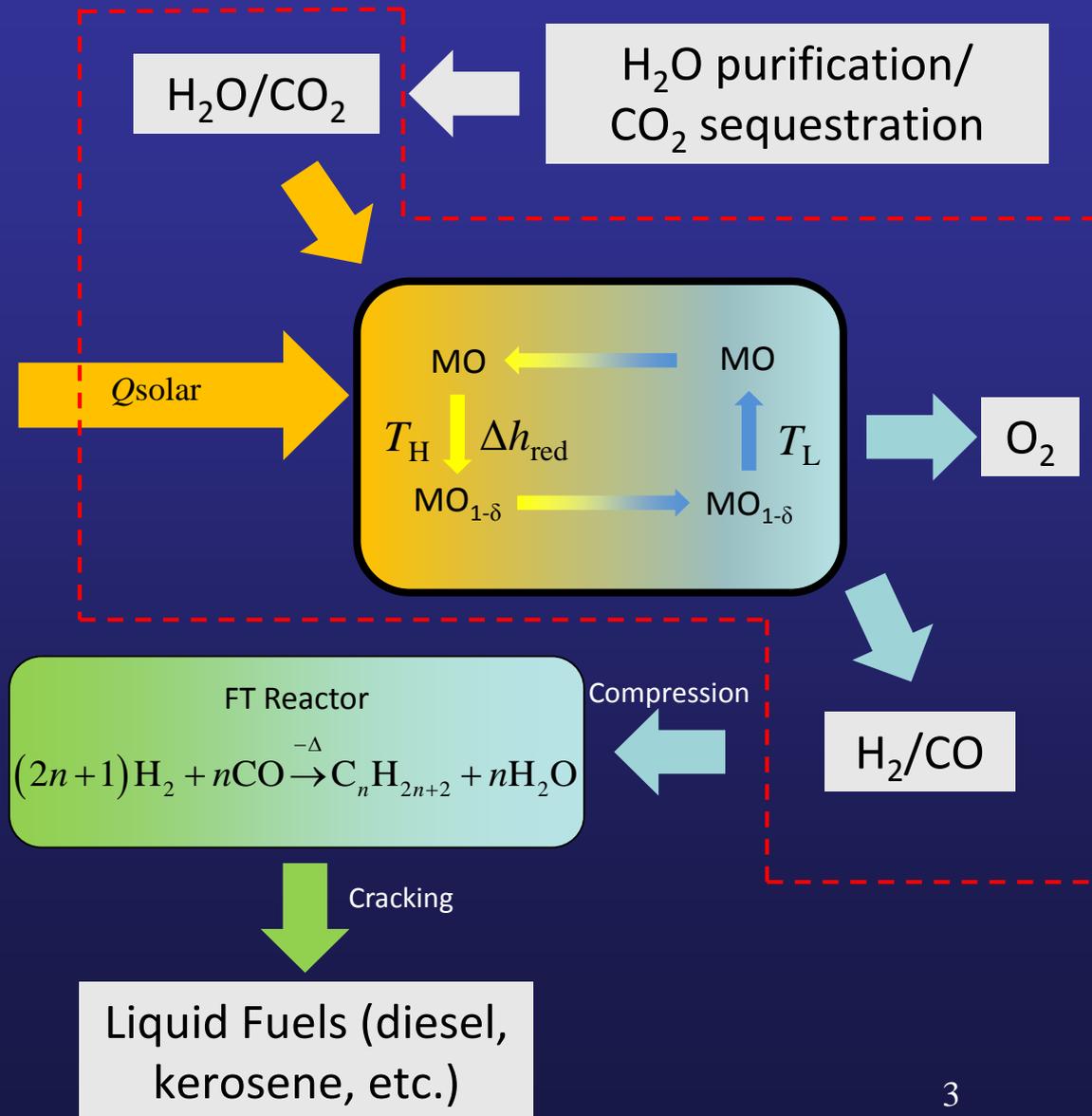
# Thermochemical Fuel Production

## 1) Fundamental Material Properties

- Thermodynamics
- Kinetics

## 2) Material Engineering

## 3) Reactor Considerations



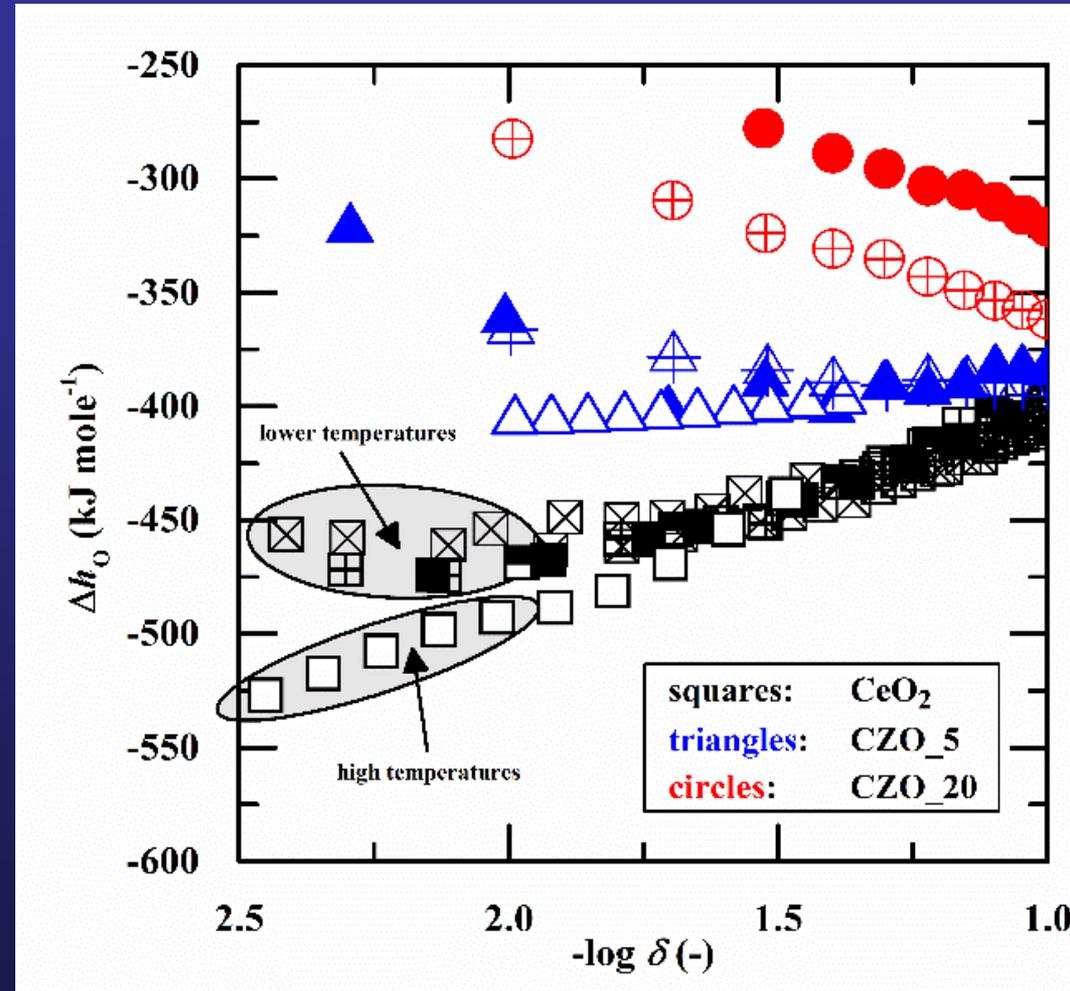
# Thermodynamic Characterization of Oxides



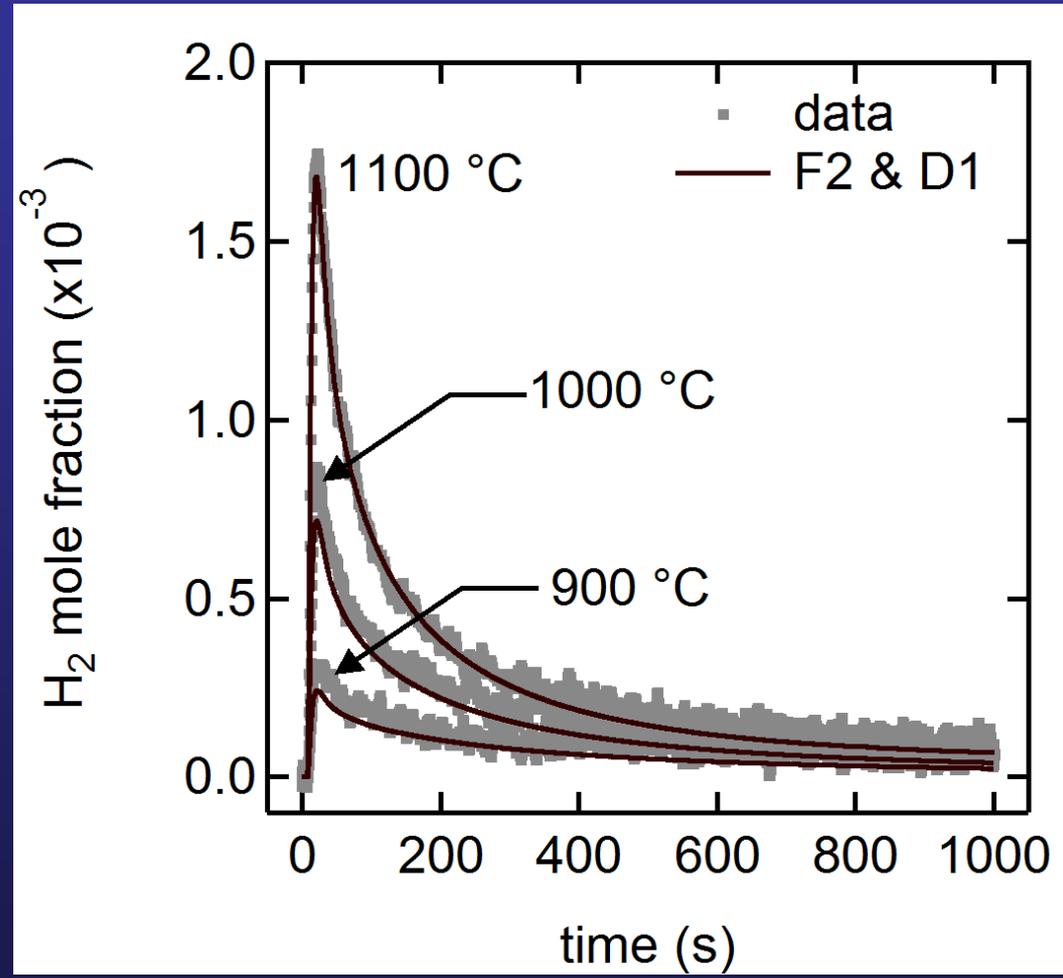
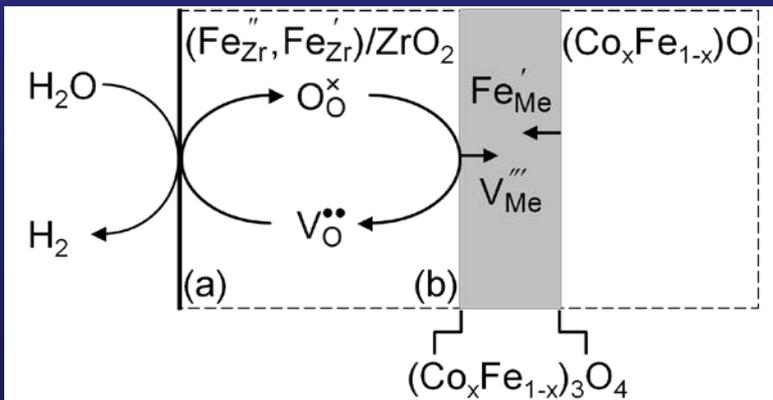
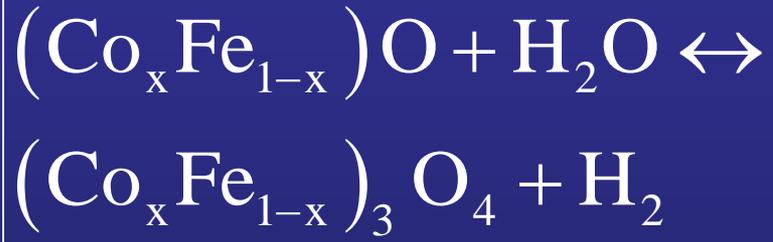
$$\Delta g_o = \Delta h_o - T \Delta s_o$$

$$\Delta g_o = \frac{1}{2} RT \ln p_{\text{O}_2}$$

$$\frac{1}{2} \ln p_{\text{O}_2} = \frac{\Delta h_o}{RT} - \frac{\Delta s_o}{R} \Big|_{\delta=\text{const.}}$$



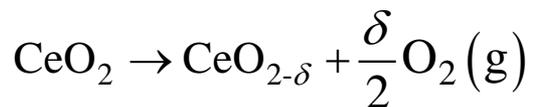
# Kinetics and Defect Chemistry of Oxides



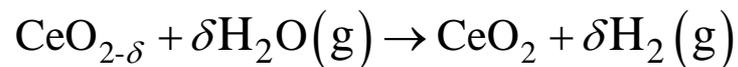
Scheffe, J. R., McDaniel A.H., Allendorf M.D., Weimer A.W., *Energy and Environmental Science* **2013**, 6 (3), 963-973

# Reactor Development

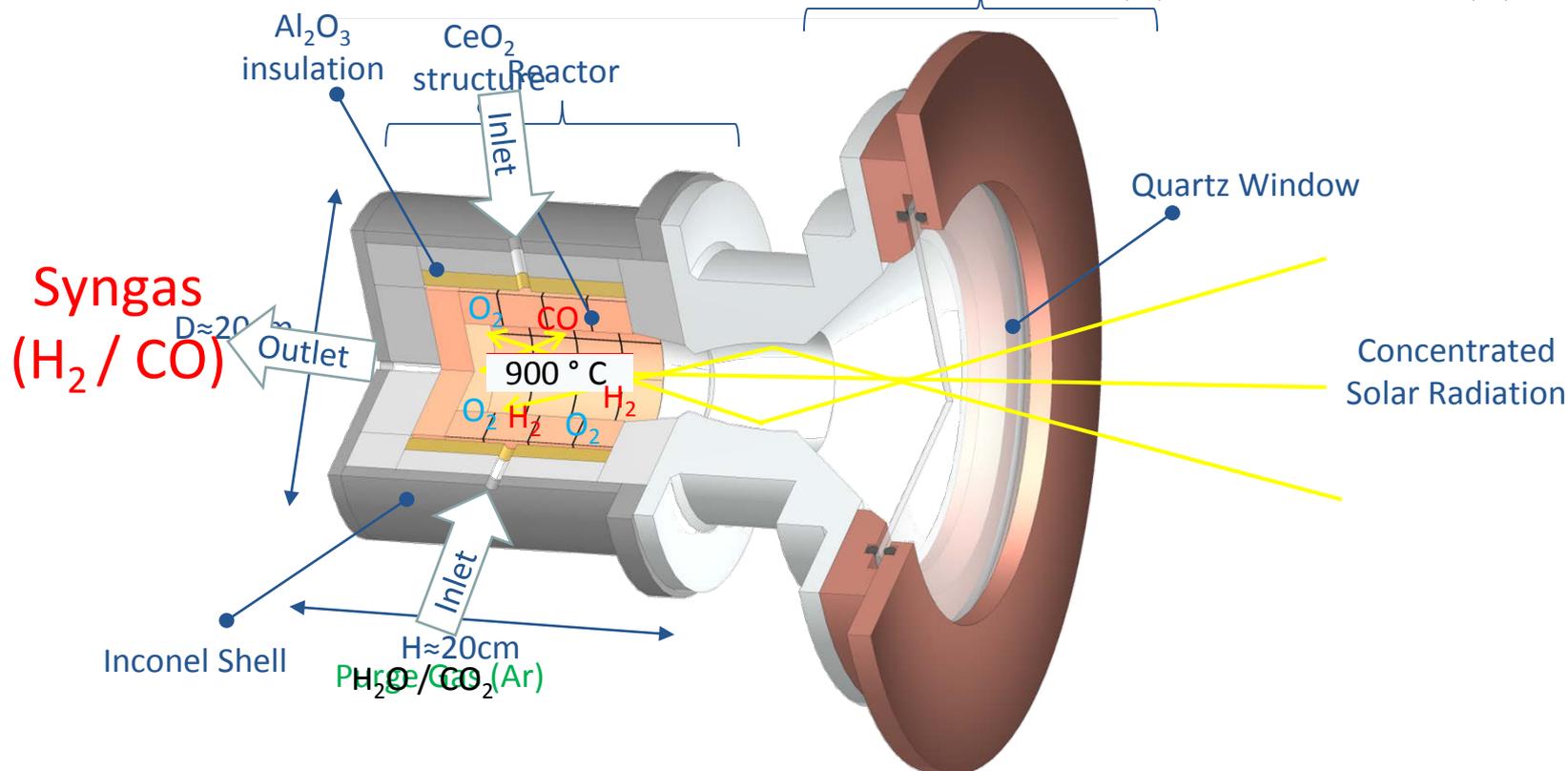
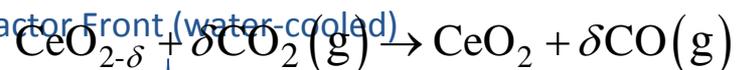
## 1. Thermal Reduction:



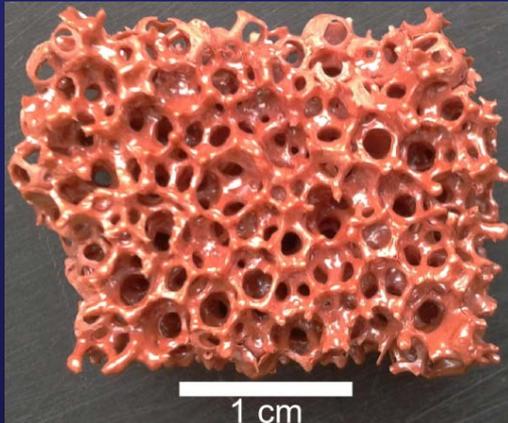
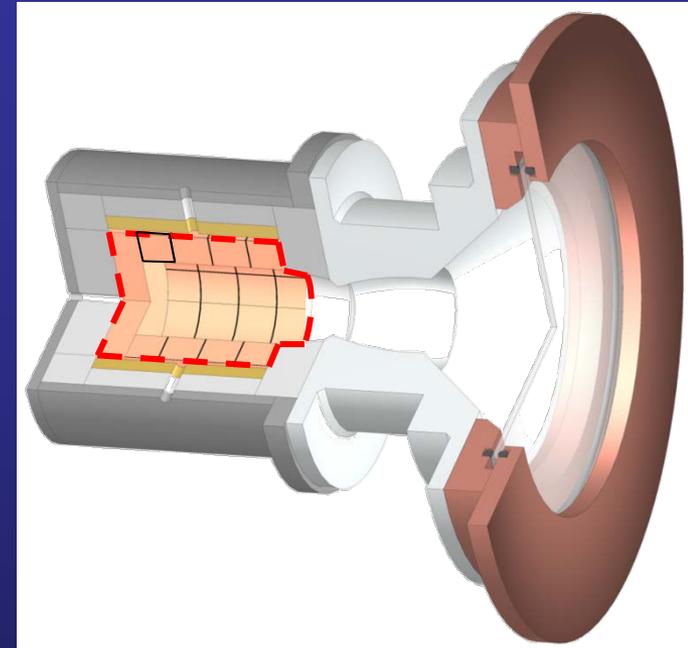
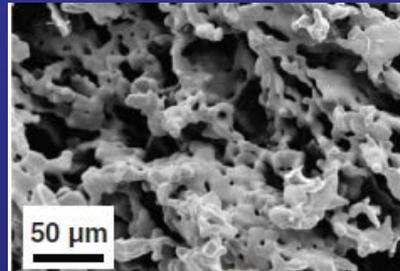
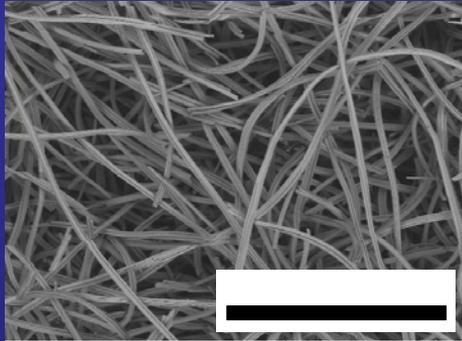
## 2. Oxidation:



Reactor Front (water-cooled)



# Material Development



## Three important features of RPC

- 1) Large length scales/low surface area
- 2) Volumetric absorption of radiation
- 3) Density roughly 15x greater than felt