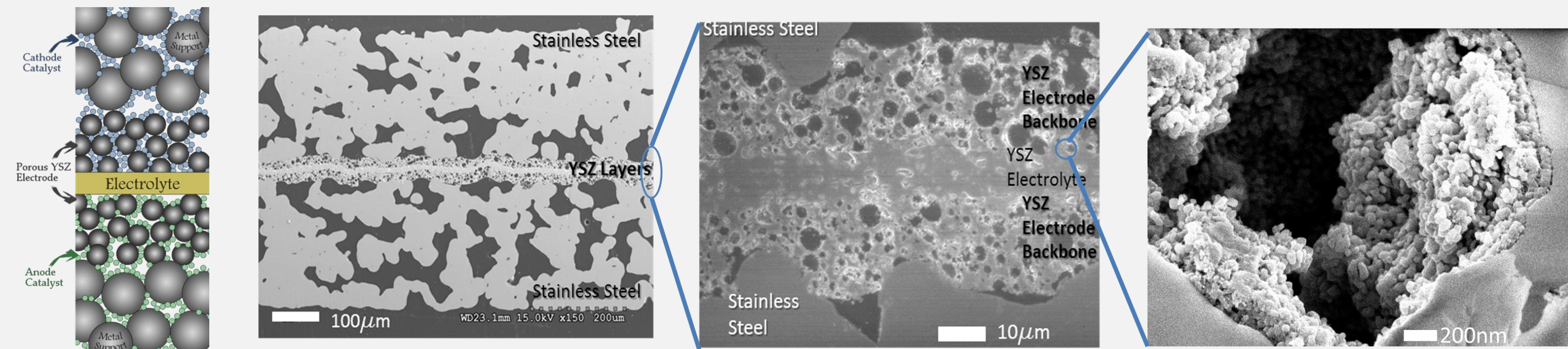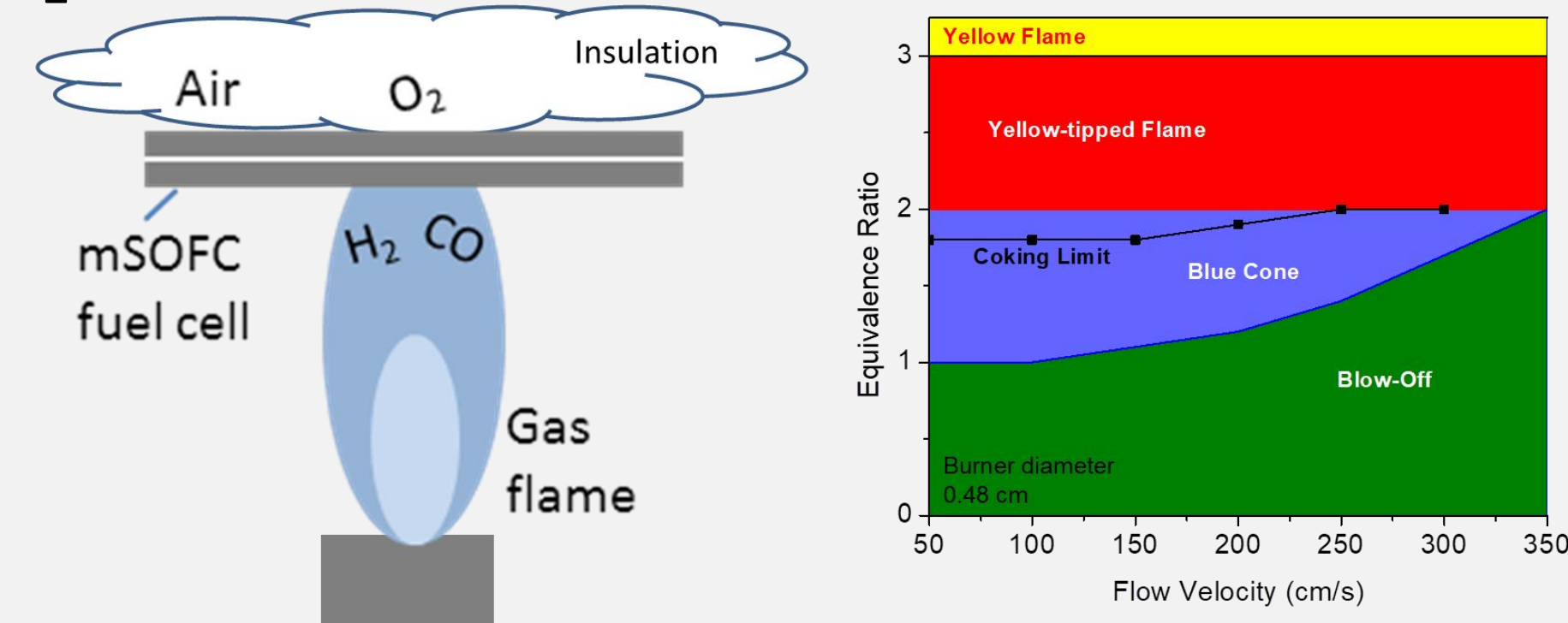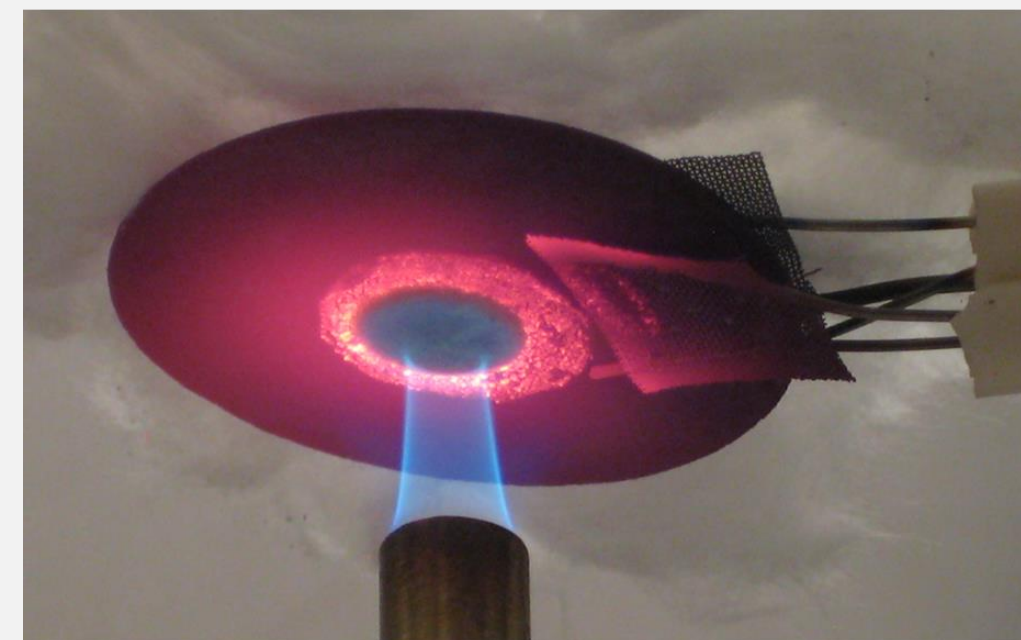## Metal-Supported Cell

Symmetric backbone of stainless steel and YSZ electrolyte/electrodes
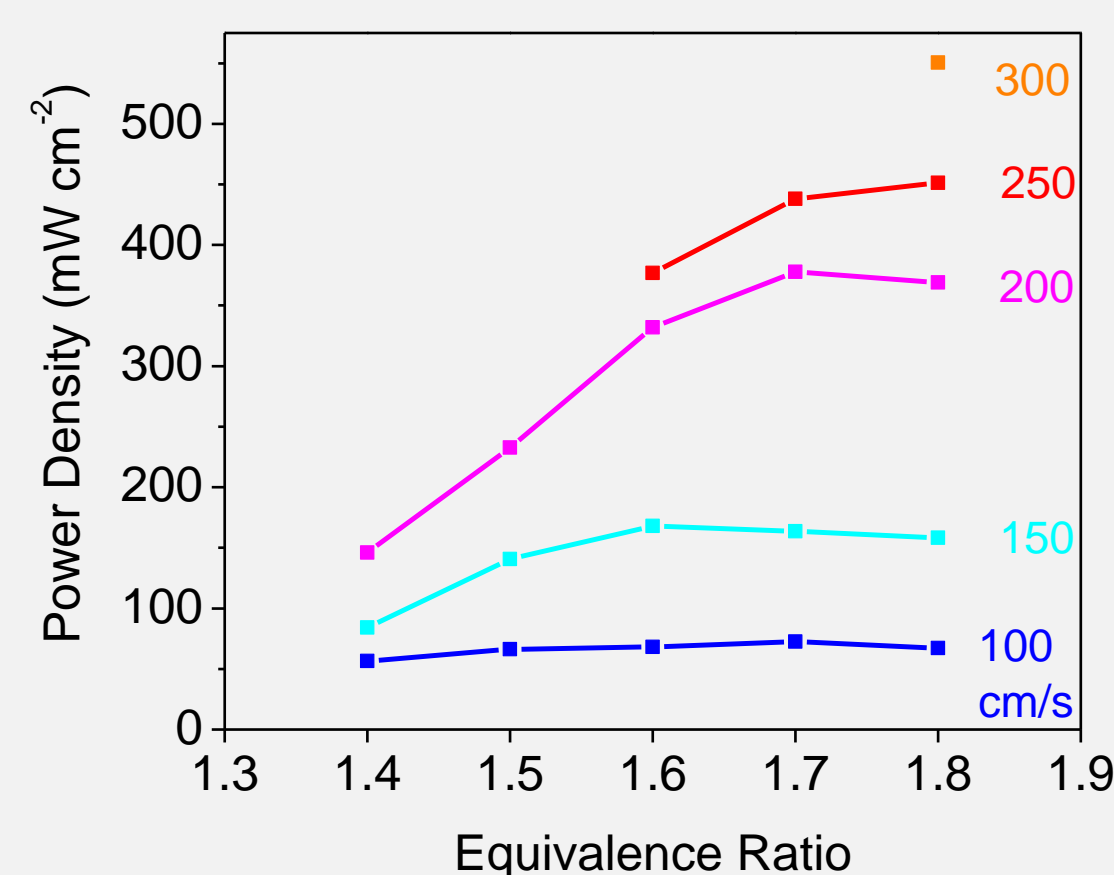
LSM and SDC-Ni infiltrated into electrodes



## Direct-Flame Operation

Flame heats cell to operating temperature (600-800°C)

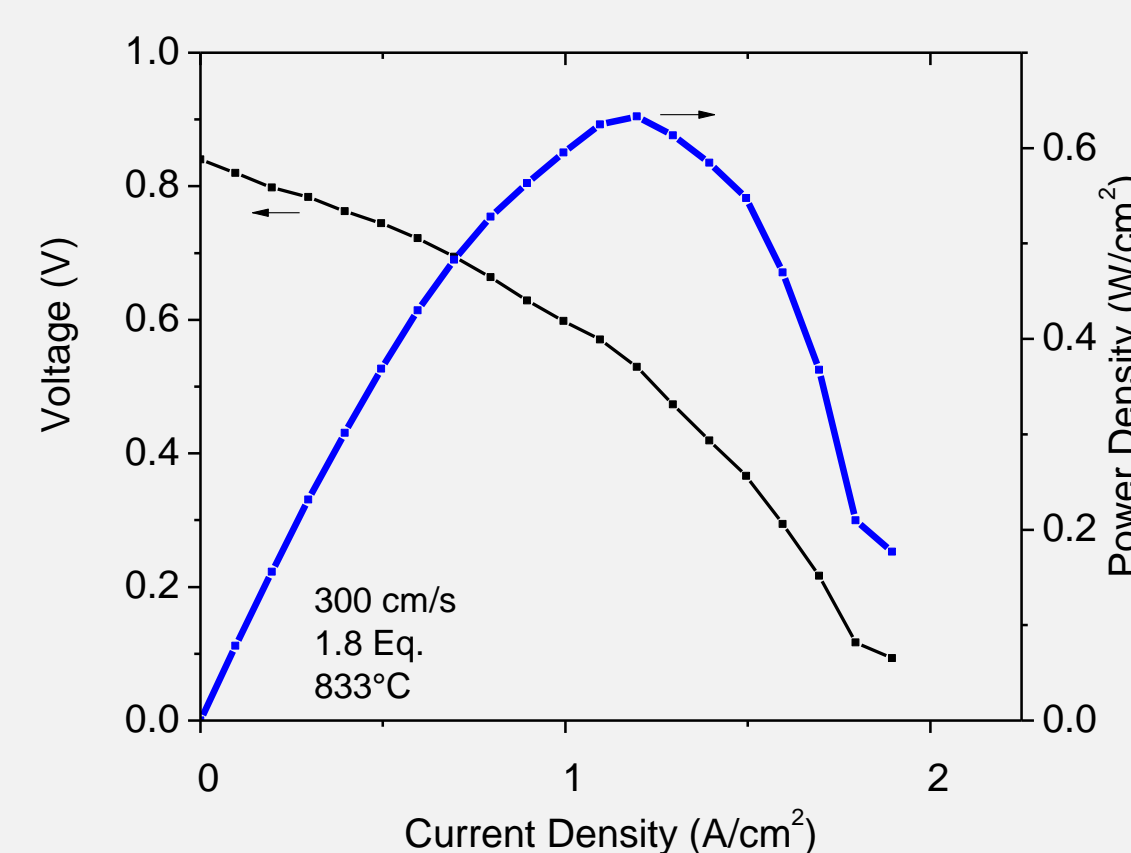Flame reforms propane to $H_2$ and CO which are consumed by the fuel cell



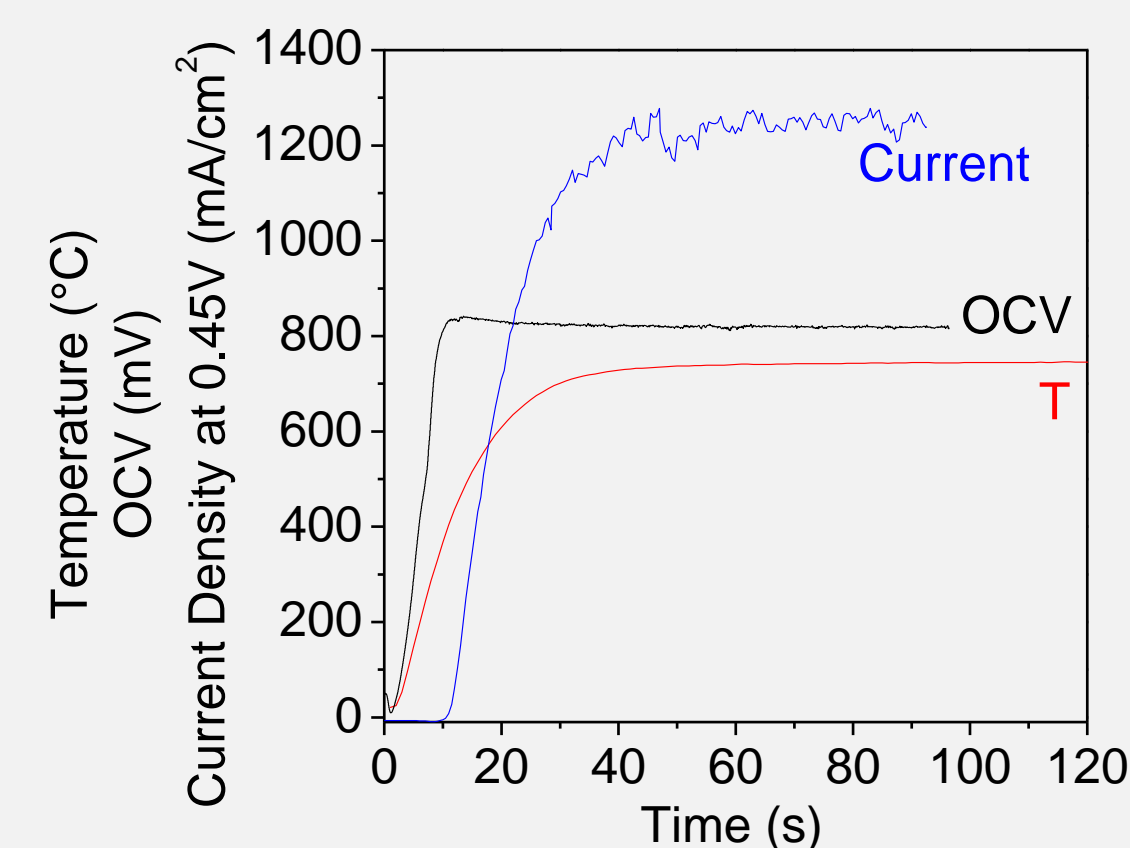## Performance

### Single cell in controlled flame



300
250
200
150
100 cm/s

### Maximum power 0.63 $W/cm^2$

Mass transport limited - low $H_2$,CO concentrations in flame
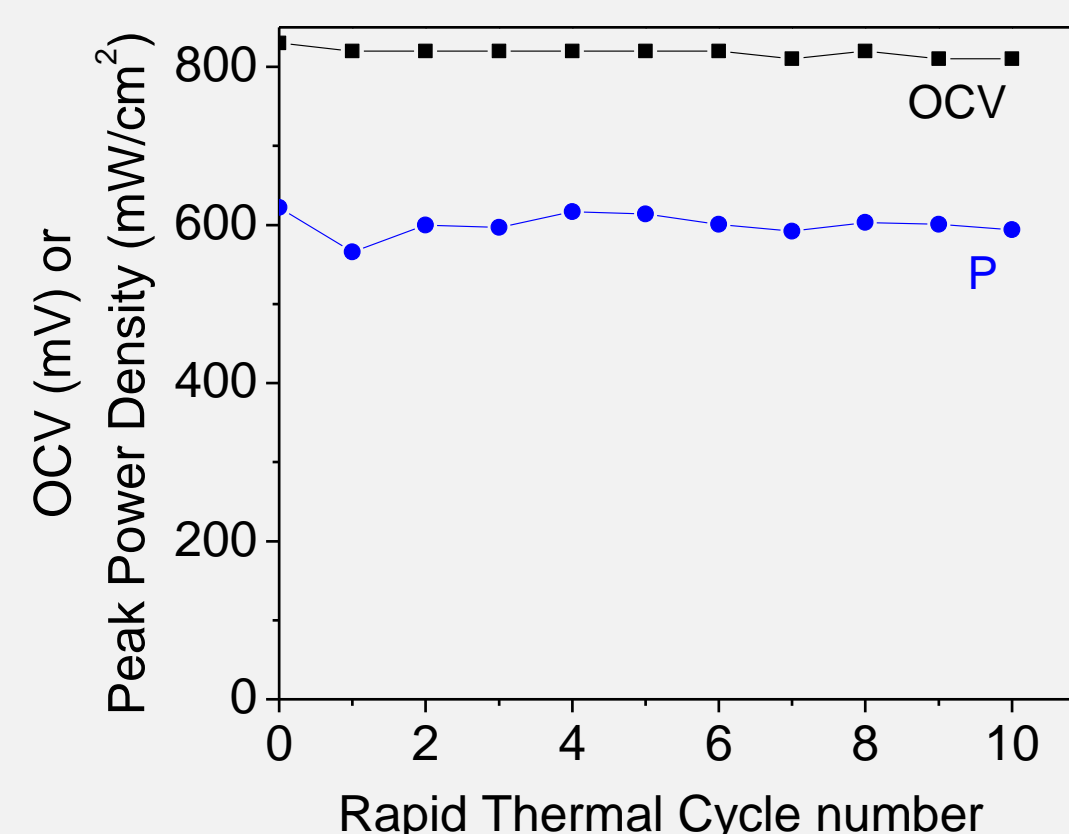
Among highest flame-SOFC power reported



300 cm/s
1.8 Eq.
833°C

## Extremely Rapid Thermal Cycling

### Power in 10 seconds



Current
OCV
T

### Tolerates continuous heat/cool cycles



OCV
P

## Stand-Alone Product Prototype



### Nighttime outdoor operation
LED lighting and mobile phone charging on demand



### 5-Cell MS-SOFC Stack
Steel mesh electrical connections spot-welded to cells
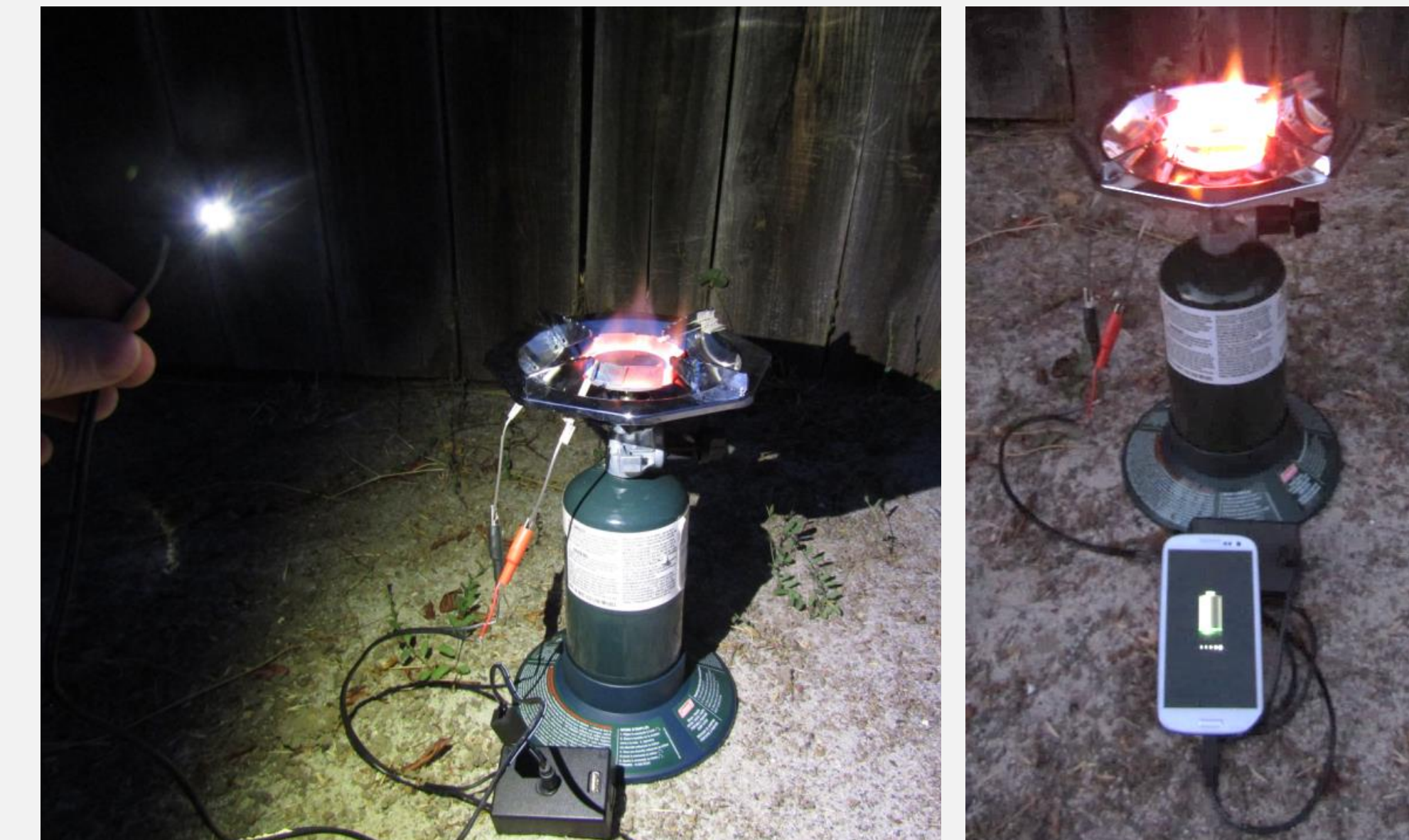


### Stack performance
Maximum power 2.7W



PHONE
4.95V 0.26A
4500 lux
LED
7000 lux
Low Flame
High Flame
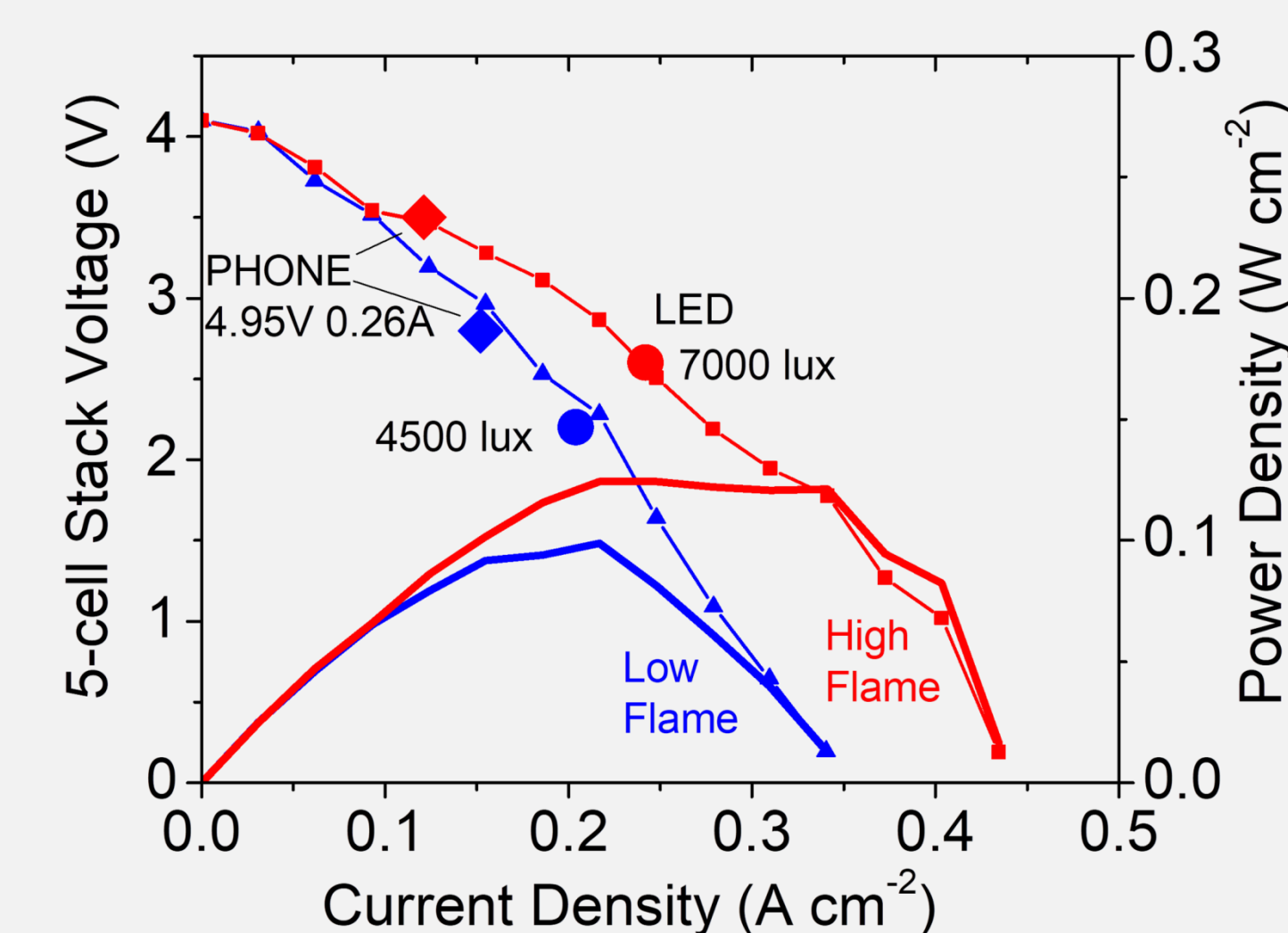
### Weekend camping scenario
Survives 5 cooking sessions



Refill pot with water
Shutoff and cool to RT
Replace propane tank
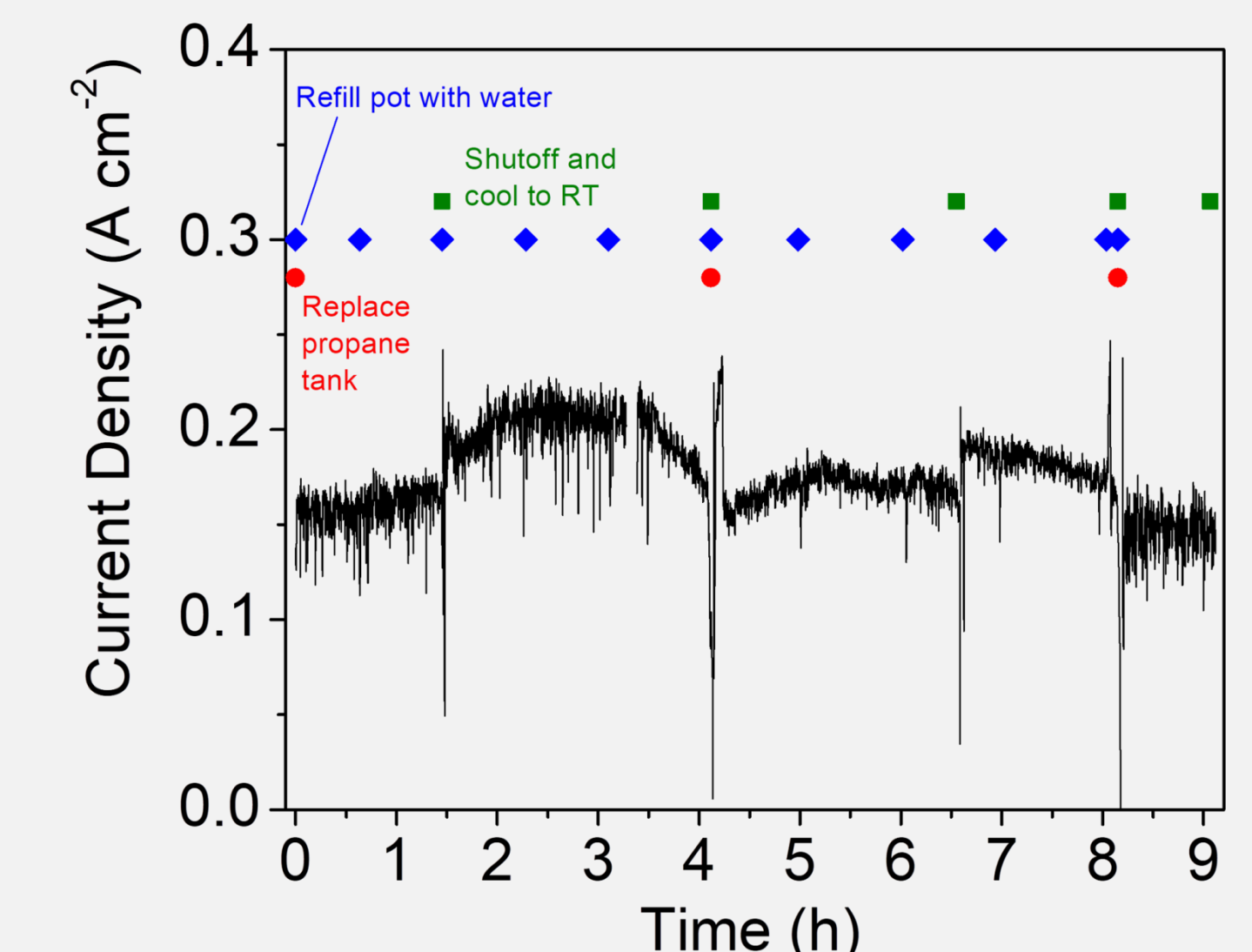
## Commercialization Activities

- Cost analysis
- Customer discovery: interviewing stakeholders throughout the value chain
- Demonstration to manufacturing partners (SOFC and camping stove companies)

## Publications and presentations

Personal power using metal-supported solid oxide fuel cells operated in a camping stove flame, M.C. Tucker, IJHE , 43, 8991-8998 (2018)

Metal-supported solid oxide fuel cells operated in direct-flame configuration, M.C. Tucker and A.S. Ying, IJHE, 38, 24426-24434 (2017)

Portable Generator Based on Direct-Flame Metal-Supported Solid Oxide Fuel Cells (MS-SOFCs), M.C. Tucker, 233rd ECS Meeting (2018)

Direct-Flame Metal-Supported Solid Oxide Fuel Cells, M.C. Tucker and A. Ying, 231st ECS Meeting (2017)