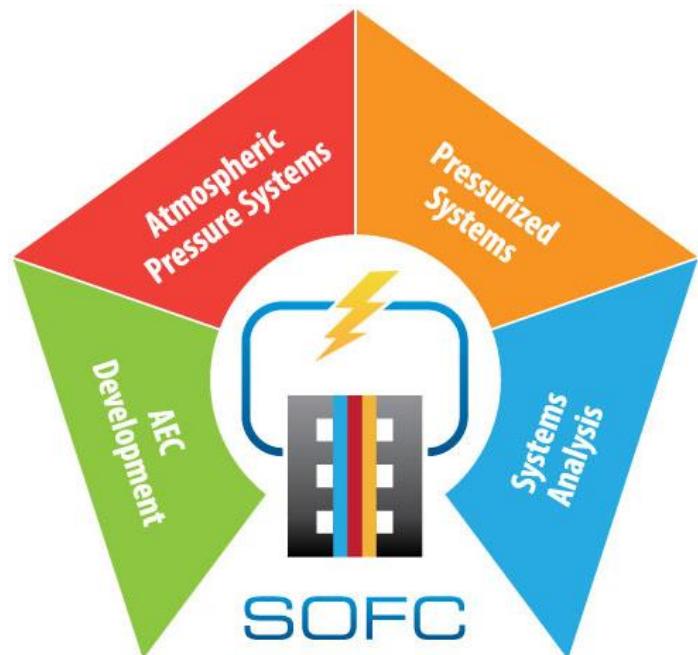


Explore the Role of Interlayer Chemistry on the Cathode Performance and Performance Stability

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Outline

1. Technical and Scientific Background

Necessity and relevance

2. Project Objectives

Role of the interlayer on cathode durability

Theoretical analysis

3. Technical Approaches

Experimental and theoretical modeling

4. Project Budget and Period

Cost share, equipment

5. Project Management Plans

Investigators and risk analysis

A Long-Lasting Challenge in SOFC Electrode Development

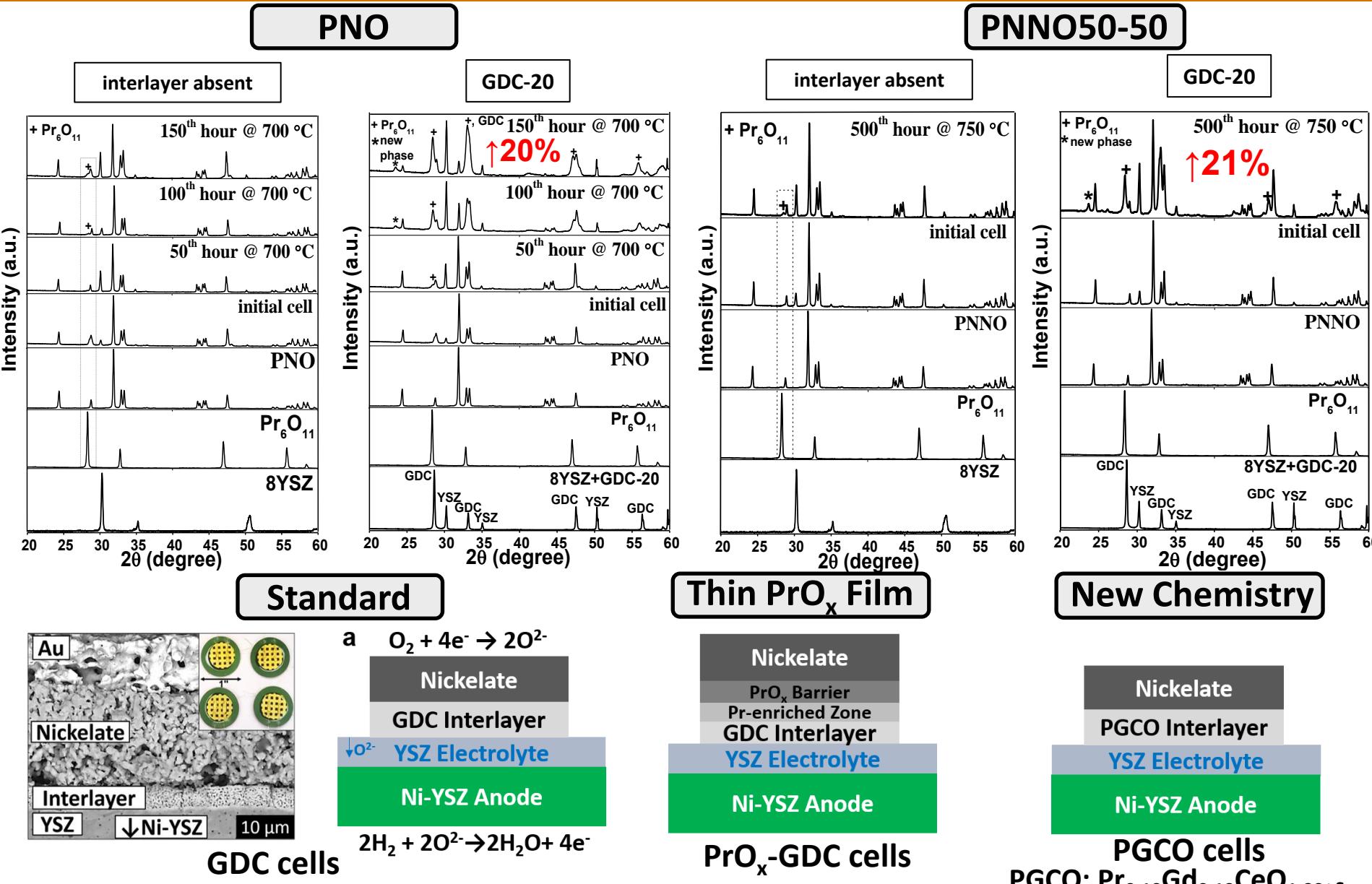
How to achieve high-performance and highly durable electrode?

In terms of the technological development

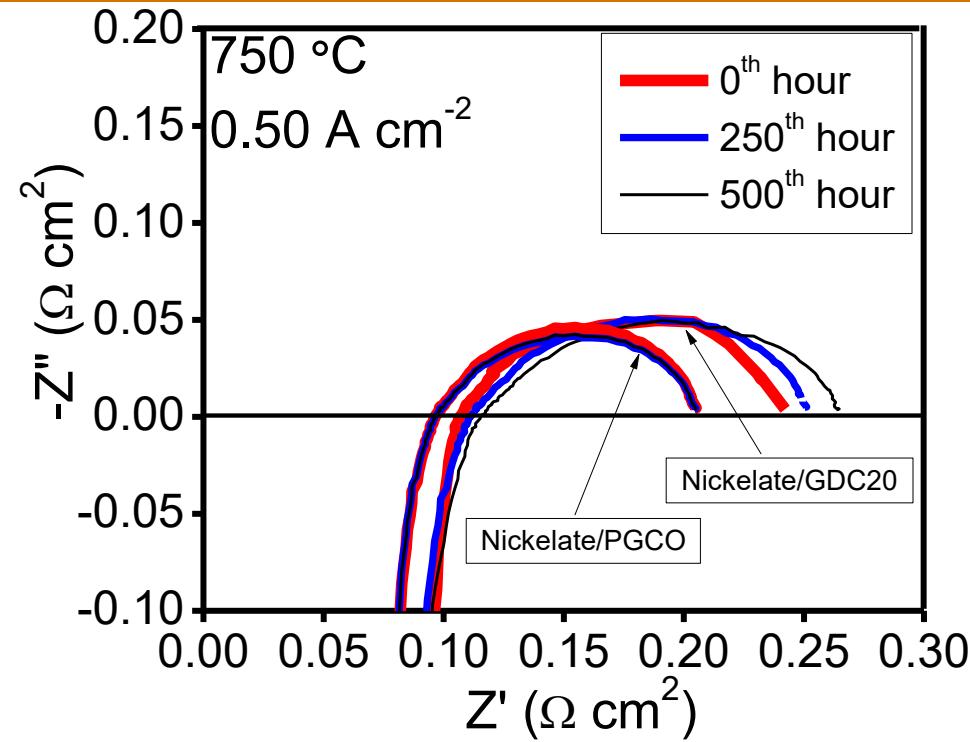
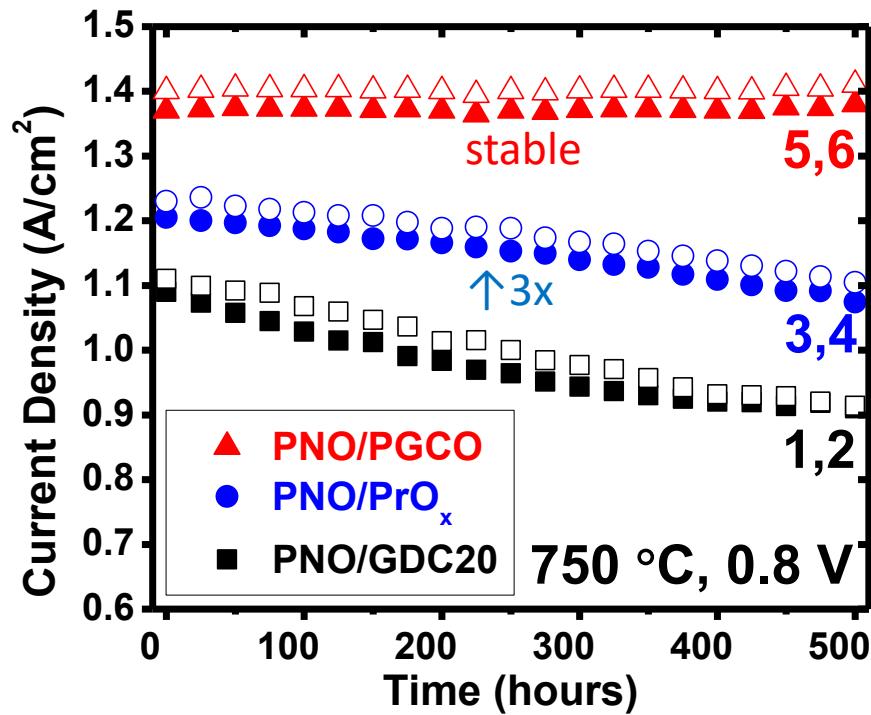
What is the mechanism that underlies the strong correlation between activity and stability?

In terms of the scientific advance

Role of Interlayer on the Phase Evolution?



Performance Stability vs. Interlayer Chemistry



Points to take:

- Multiple cells for each condition for both PNO and PNNO electrodes
- 3x reduced performance degradation in PNO/PrO_x cells.
- Stable operation was measured on multiple sets of cells and cathode compositions with the PGCO interlayer.
- Reduced R_{pol} ($\uparrow \text{MIEC} \rightarrow \uparrow \sigma_e$) due to extended rxn. zone.
- Reduced Rohm ($\downarrow R_{\text{gb}}$ with $[\text{Pr}] \uparrow$)¹

Summarized ASR vs. GDC cells.

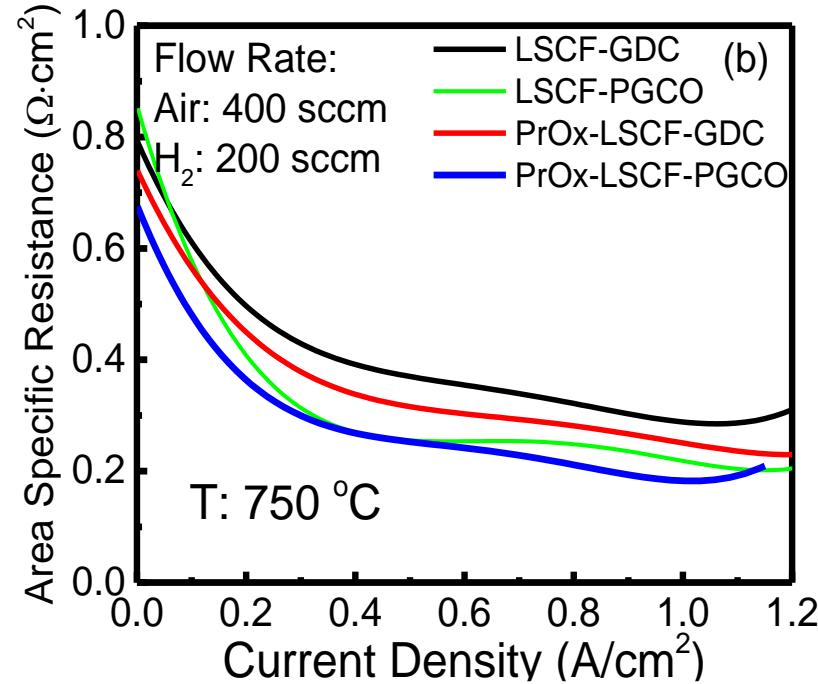
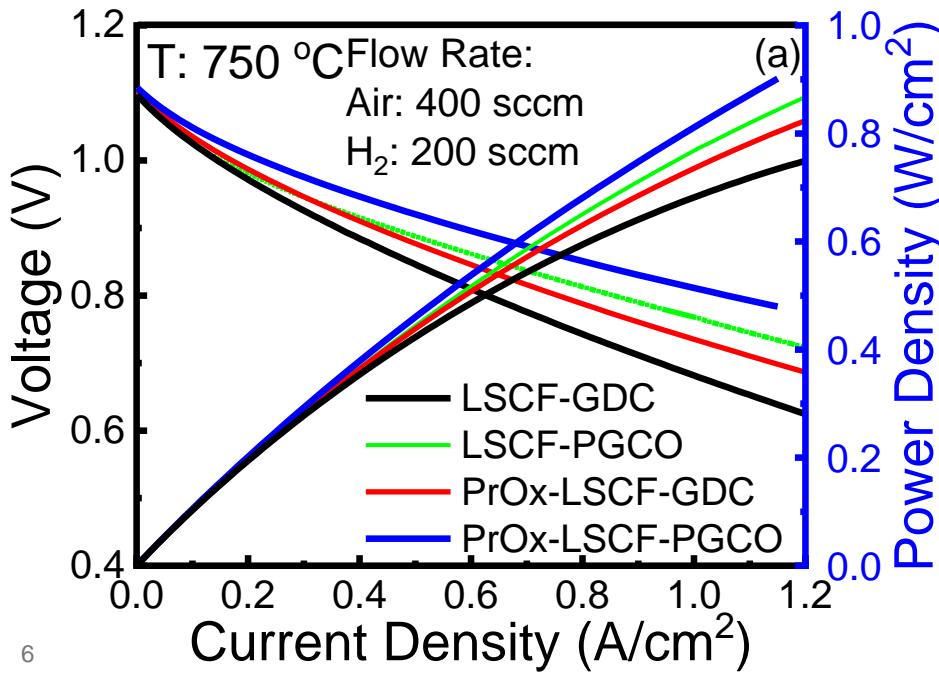
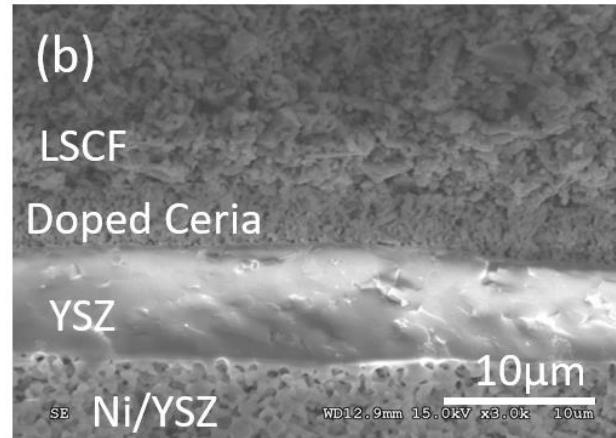
	ASR	Ohmi c	Electrod e	Total
PrOx-GDC 500 th hour	7%↓	22%↓	15%↓	
PGCO 500 th hour	16%↓	28%↓	22%↓	

Cell Performance vs. Interlayer Chemistry – LSCF Cathode

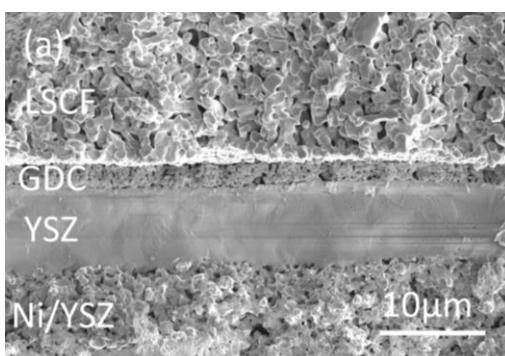
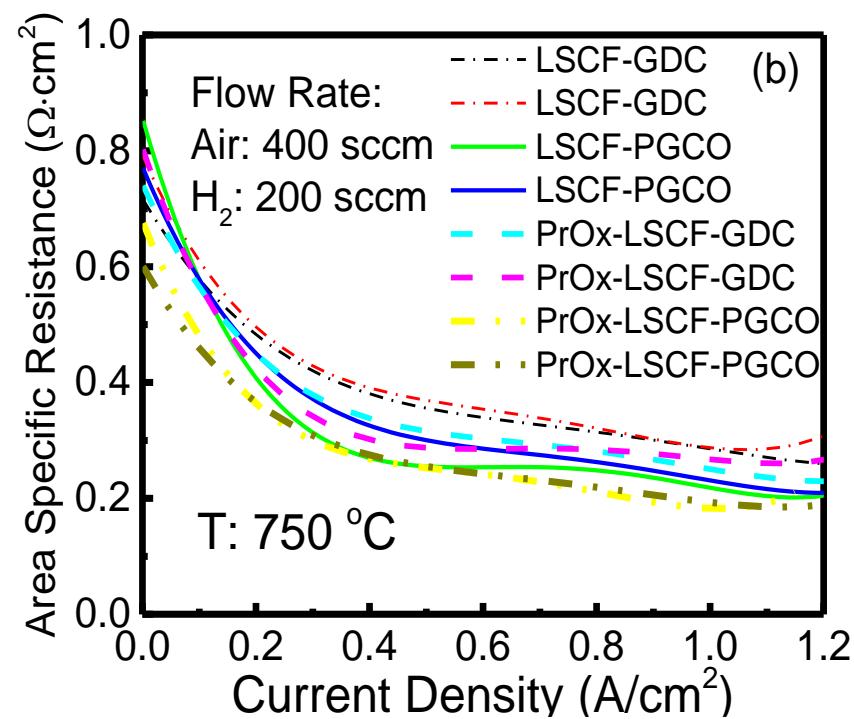
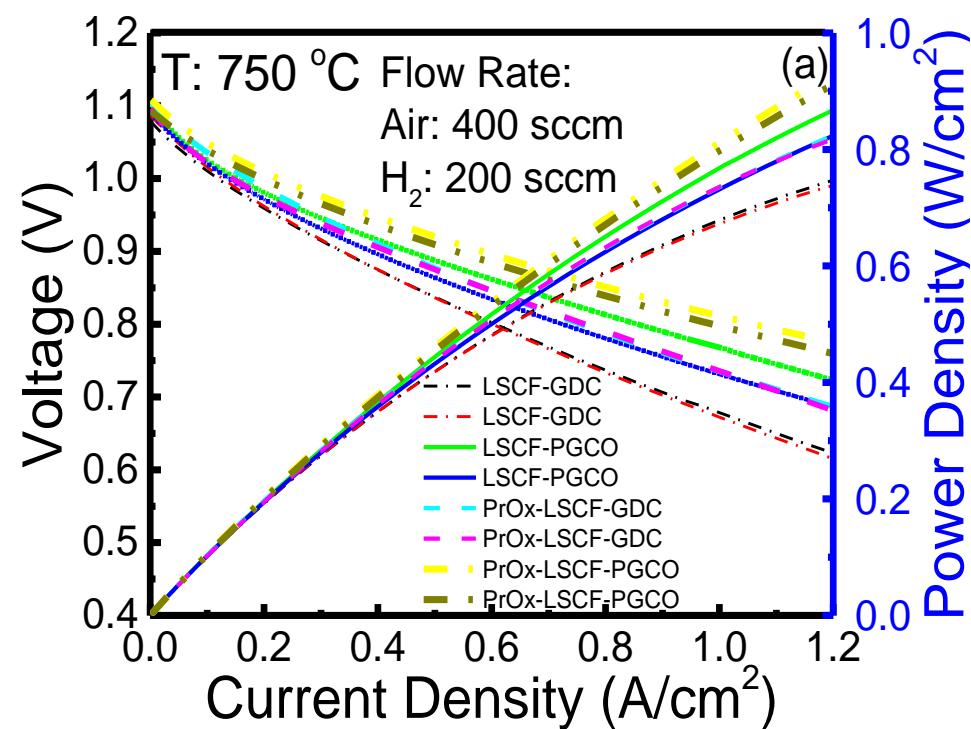
(a)



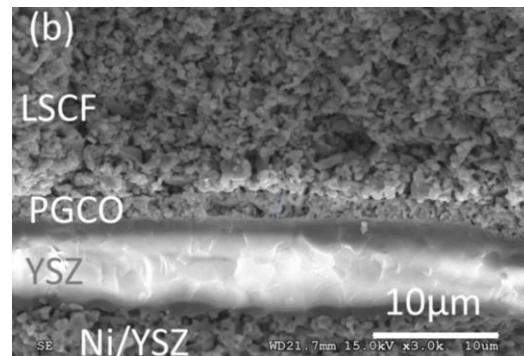
(b)



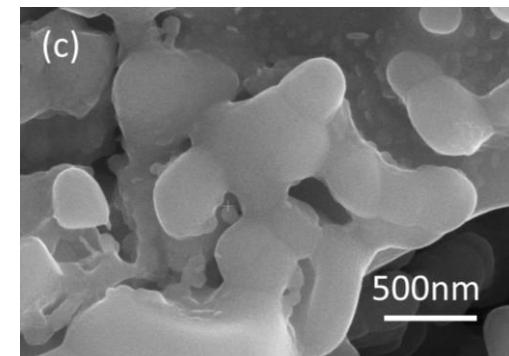
Performance Stability vs. Interlayer Chemistry – LSCF Cathode



LSCF-GDC Cell

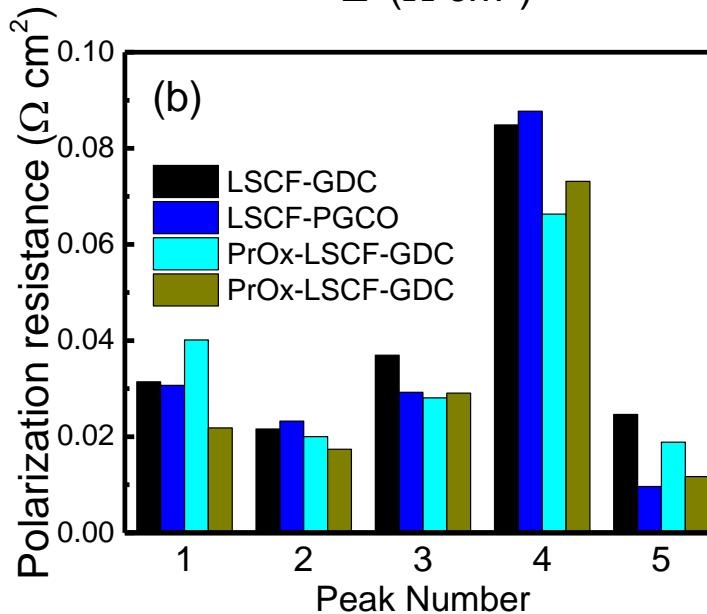
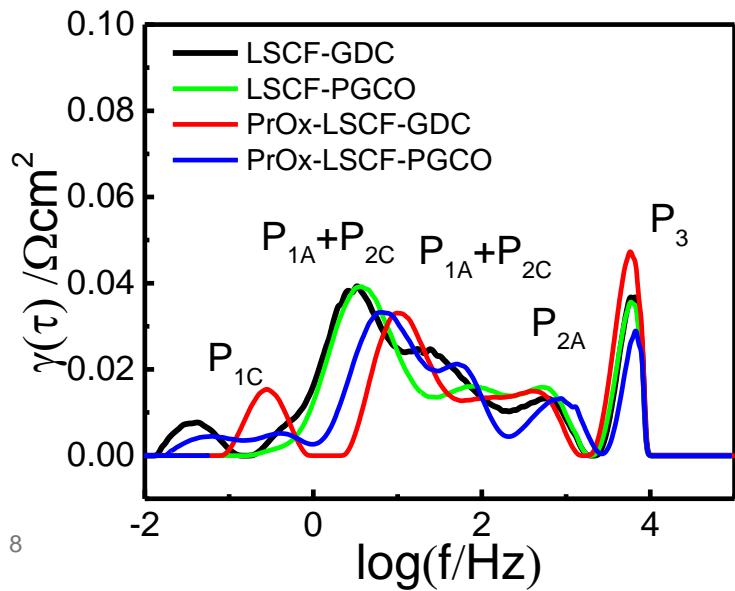
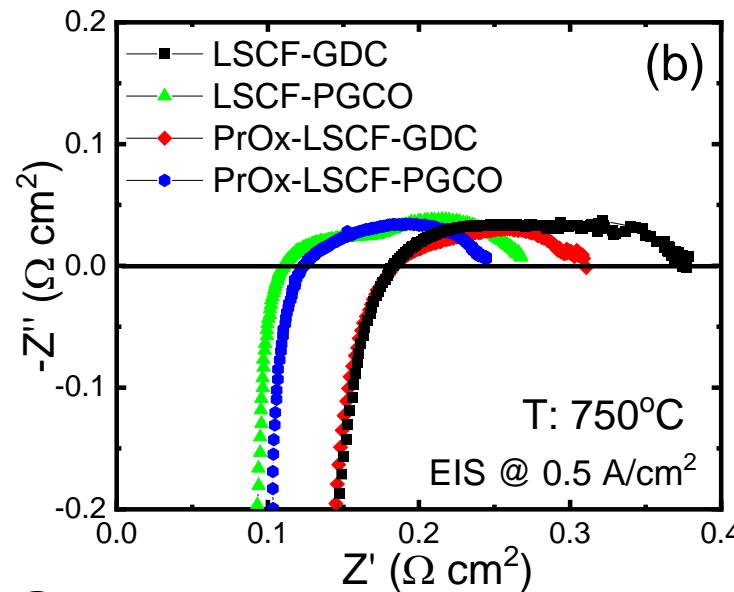
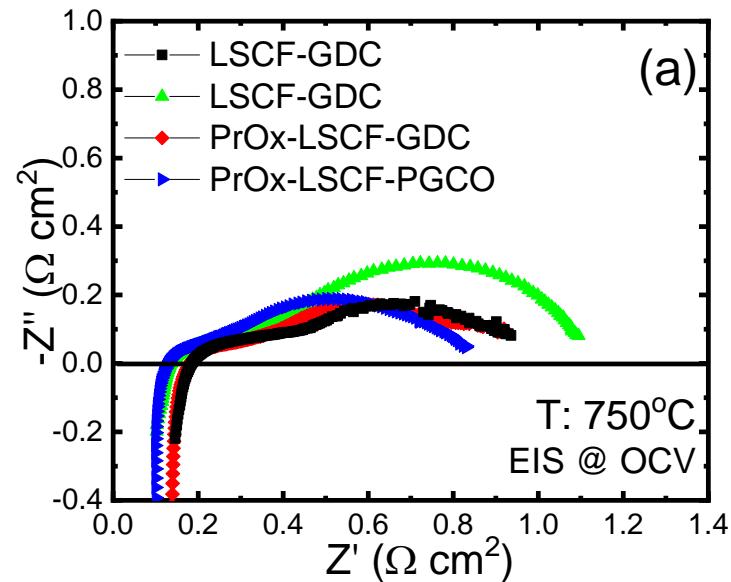


LSCF-PGCO Cell

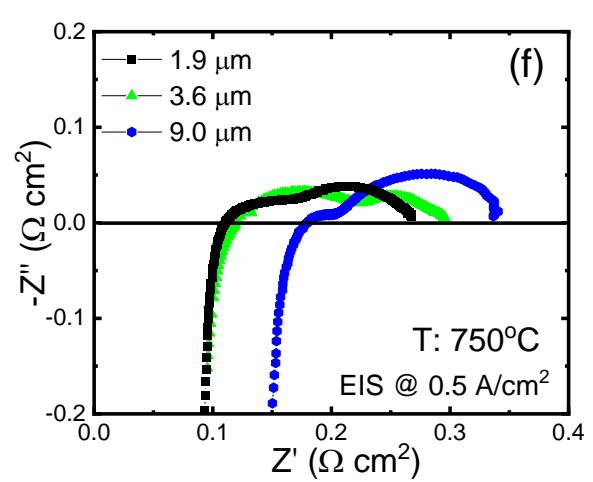
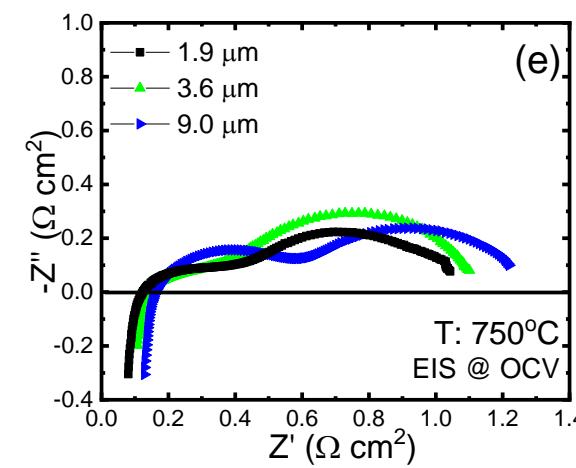
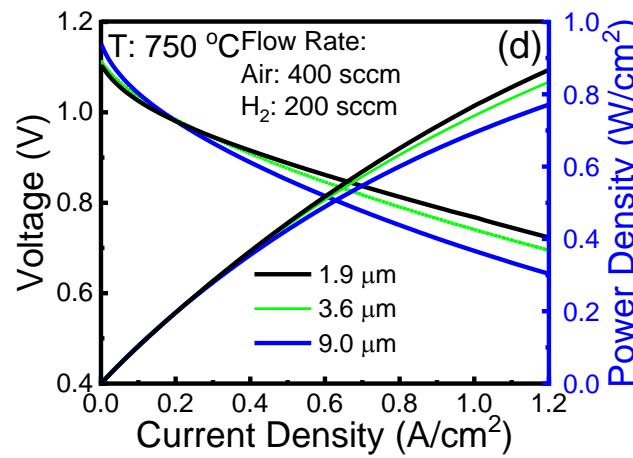
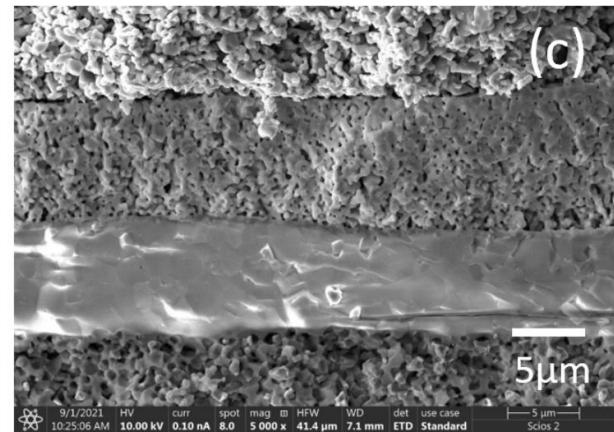
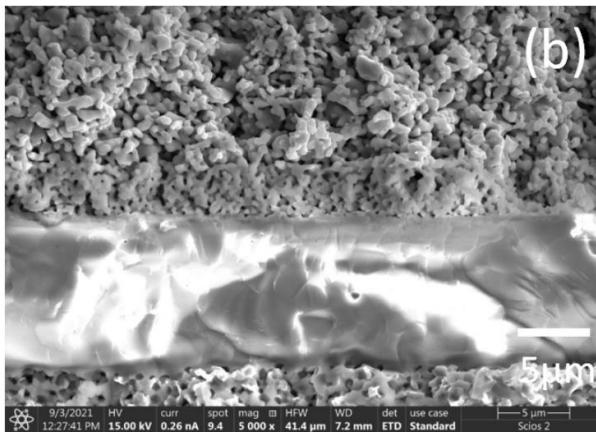
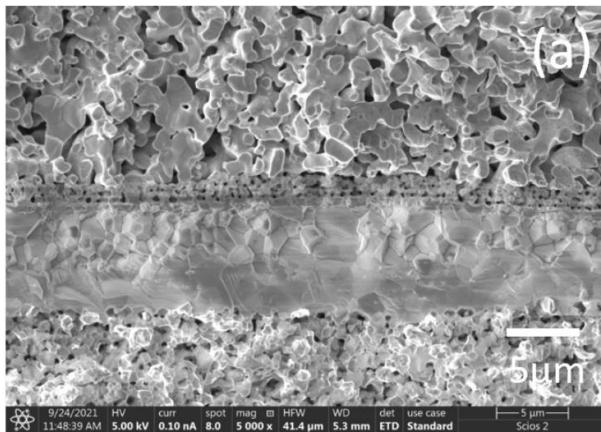


Infiltrated LSCF

Impedance Analysis – LSCF Cathode

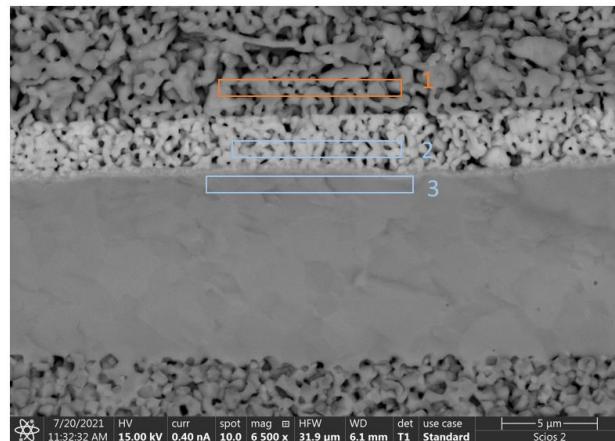
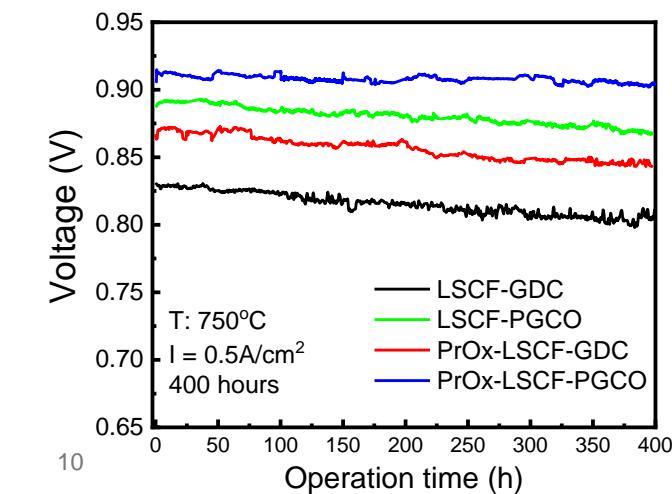
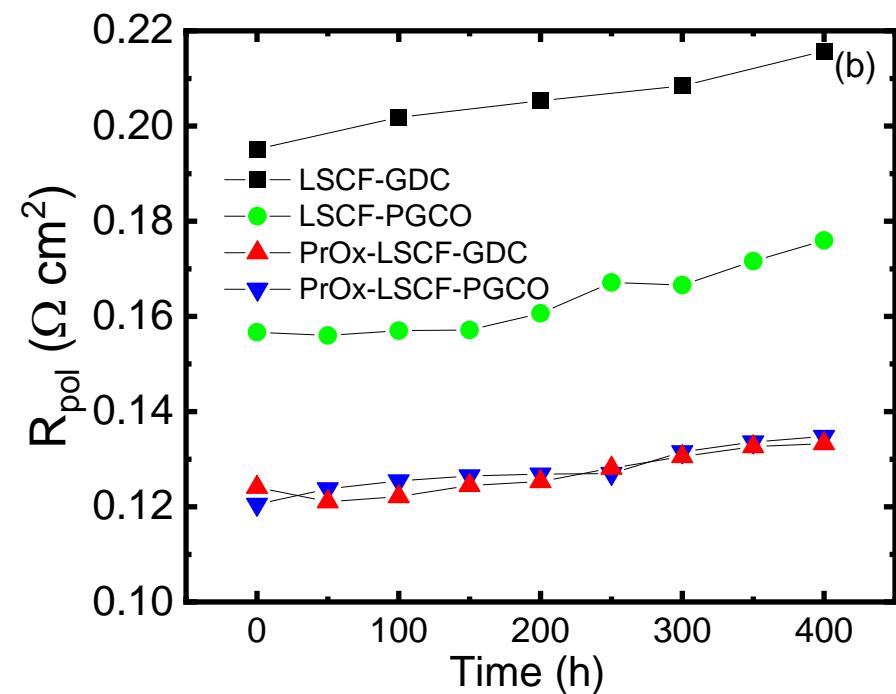
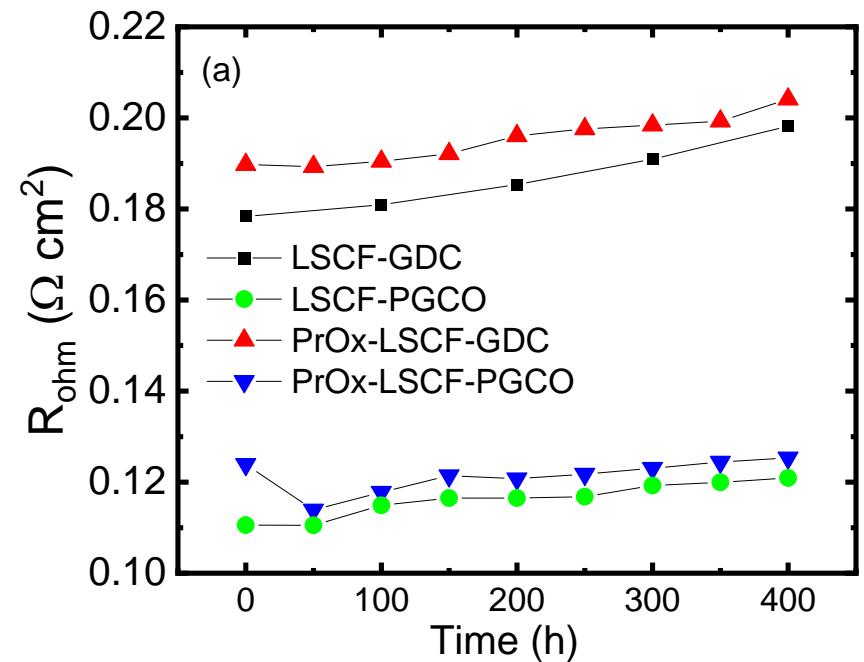


SEM Image and Cell Performance with Various Thickness of PGCO



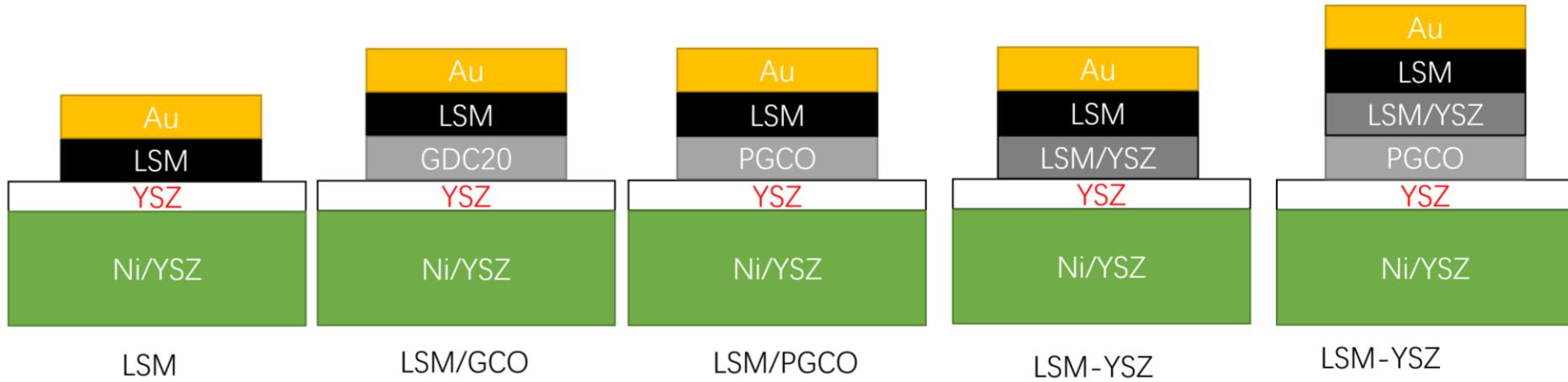
Performance Stability – LSCF

Cathode



Elements	LSCF	PGCO	YSZ
Pr atom%	0	3.72	0
Gd atom%	0	4.64	0
Ce atom%	0	25.73	0
La atom%	12.29	0	0
Sr atom%	8.65	0.74	0
Co atom%	6.13	0	0
Fe atom%	22.07	0	0
Y atom%	0	0	5.31
Zr atom%	0	0.72	29.33

Cell Architecture – LSM Cathode

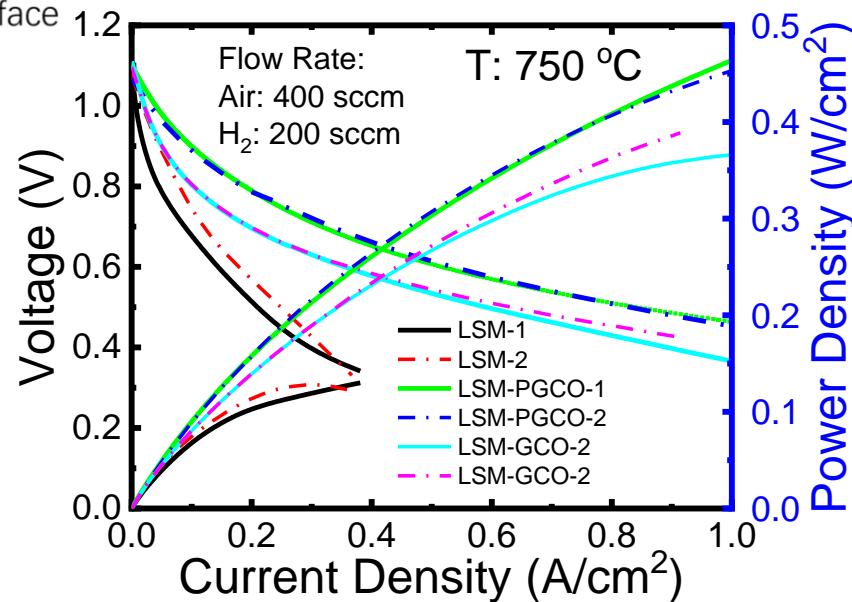


Conventional SOFC with YSZ electrolyte and LSM cathode

Conventional buffer layer, GDC, is inserted to change the interface properties

Our buffer layer, PGCO, is inserted to further change the interface properties

- Doped ceria buffer layer is needed for the SOFC with LSM cathode. This work measure the performance difference with different LSM/electrolyte interface to further illustrate the relation between cell performance and cathode/electrolyte interface properties
- An LSM electrode shows low performance at 750 °C
- With PGCO interlayer, the power density is increased, comparing with the use of GDC electrode.



Project Budget and Period

	Type	Budget	Activities	Period
DOE	Cash	\$499,999	Development of stable and active cathodes	08/02/18 – 03/30/22
UL Cost Share	Cash at UL	\$121,583	1. Graduate Student Fellow 2. Equipment	08/02/18 – 03/30/22
	In-kind at UL	\$3,417	1. Indirect cost of cash cost share	08/02/18 – 03/30/22
Total	\$624,000;		Cost share percentage: 20% (cash% = 19.5%)	

Investigators and Risk Analysis

Program Managers:

Jason Montgomery, NETL, 626 Cochrans Mill Road, Pittsburg, PA15236

Personnel at University of South Carolina

Xiao-Dong Zhou

Principal Investigator

Ram Submaraniam

Co-PI

Tom Pesacreta

HRTEM specialist at UL

Lily Ann Hume

FIB/SEM specialist

Yudong Wang

Graduate student

Alex Tucker

Undergraduate student

Chris Gros

Undergraduate student

Austin Schilling

Undergraduate student

Risks:

Risk #1: Correlation between modeling and experimental evaluations

Risk #2: The effect of porosity of the interlayer on cathode durability

Risk #3: Cathode materials in reducing conditions

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