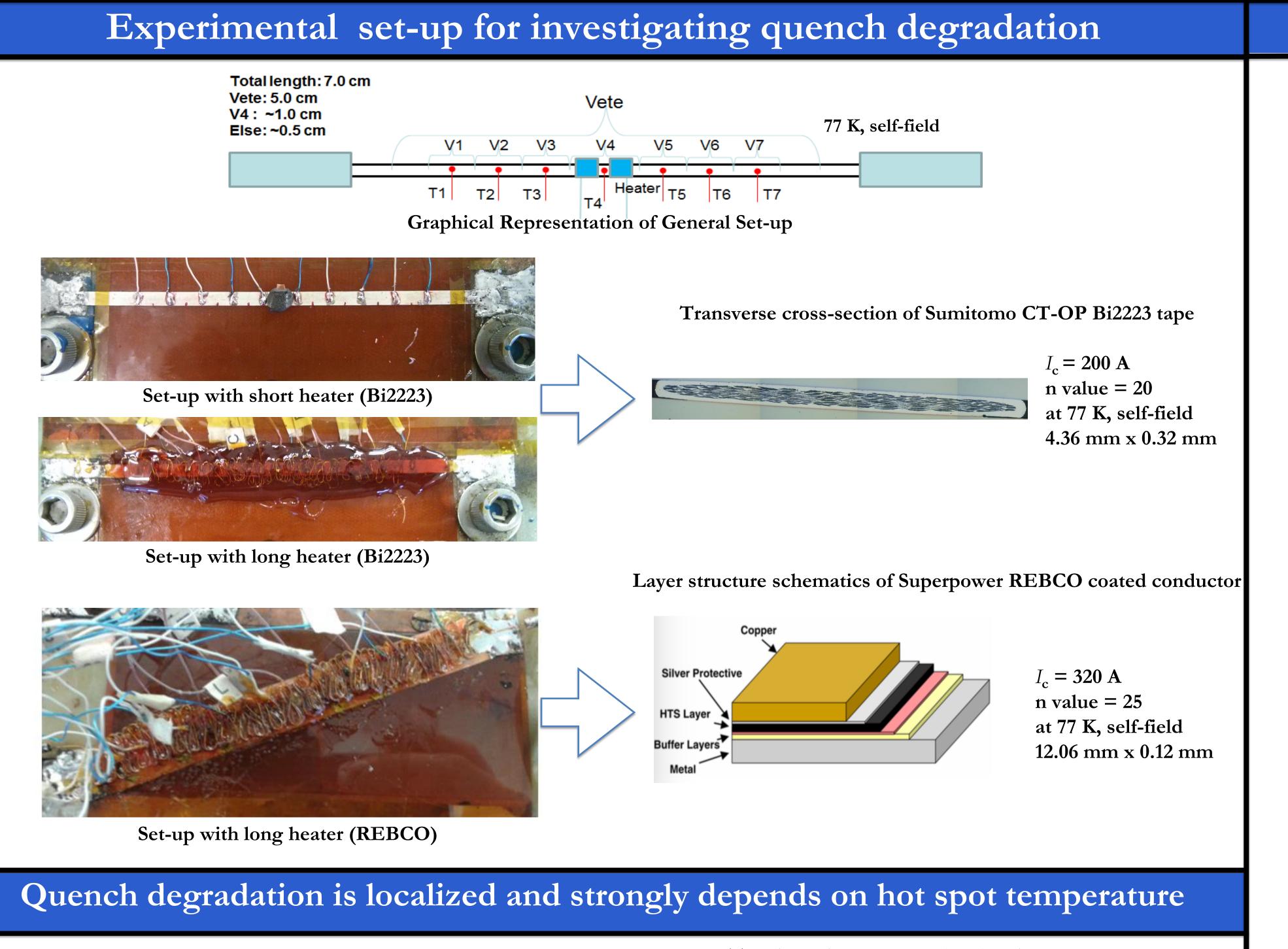


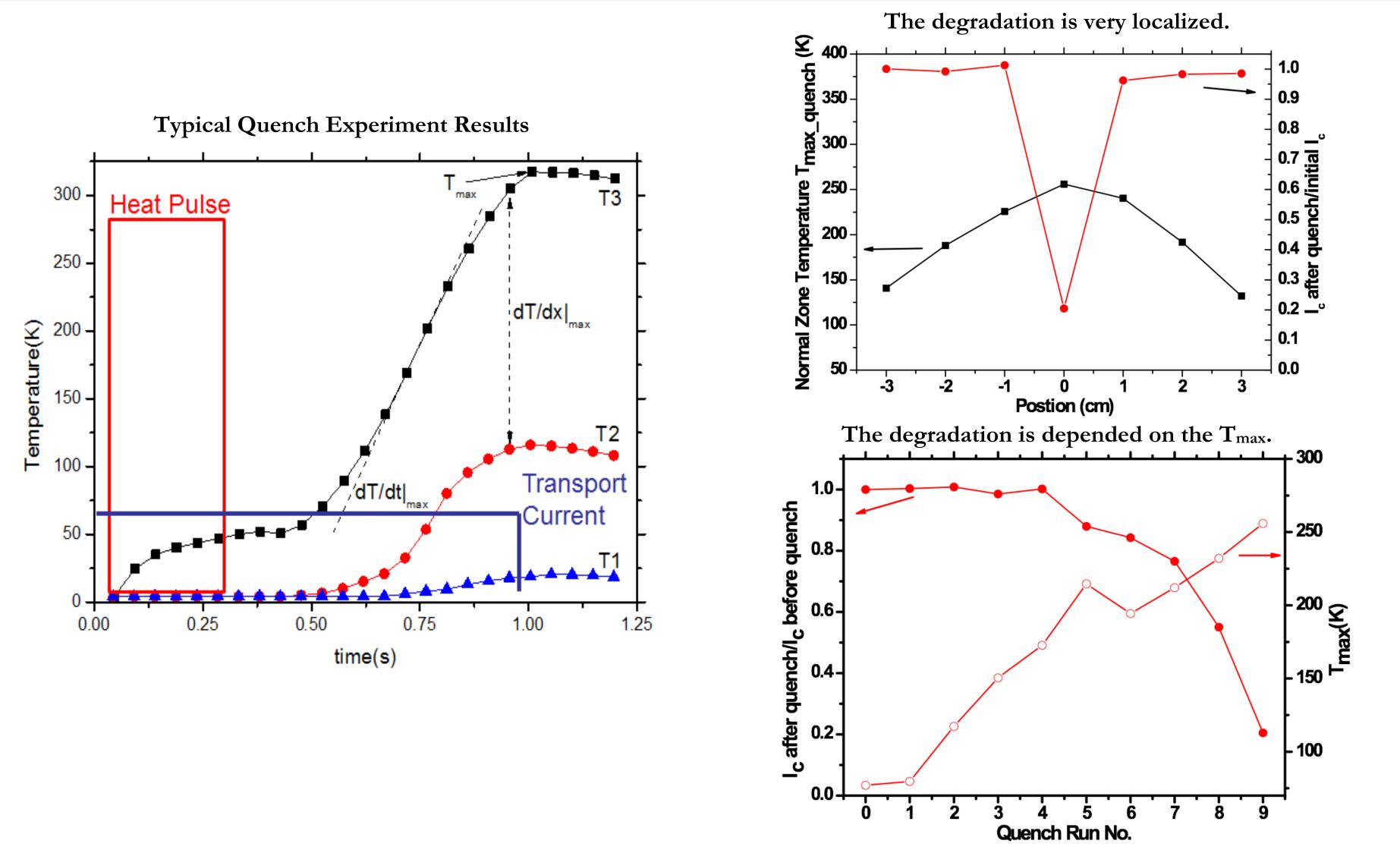
## Quench induced critical current degradation in REBCO coated conductors and Bi2223 tapes



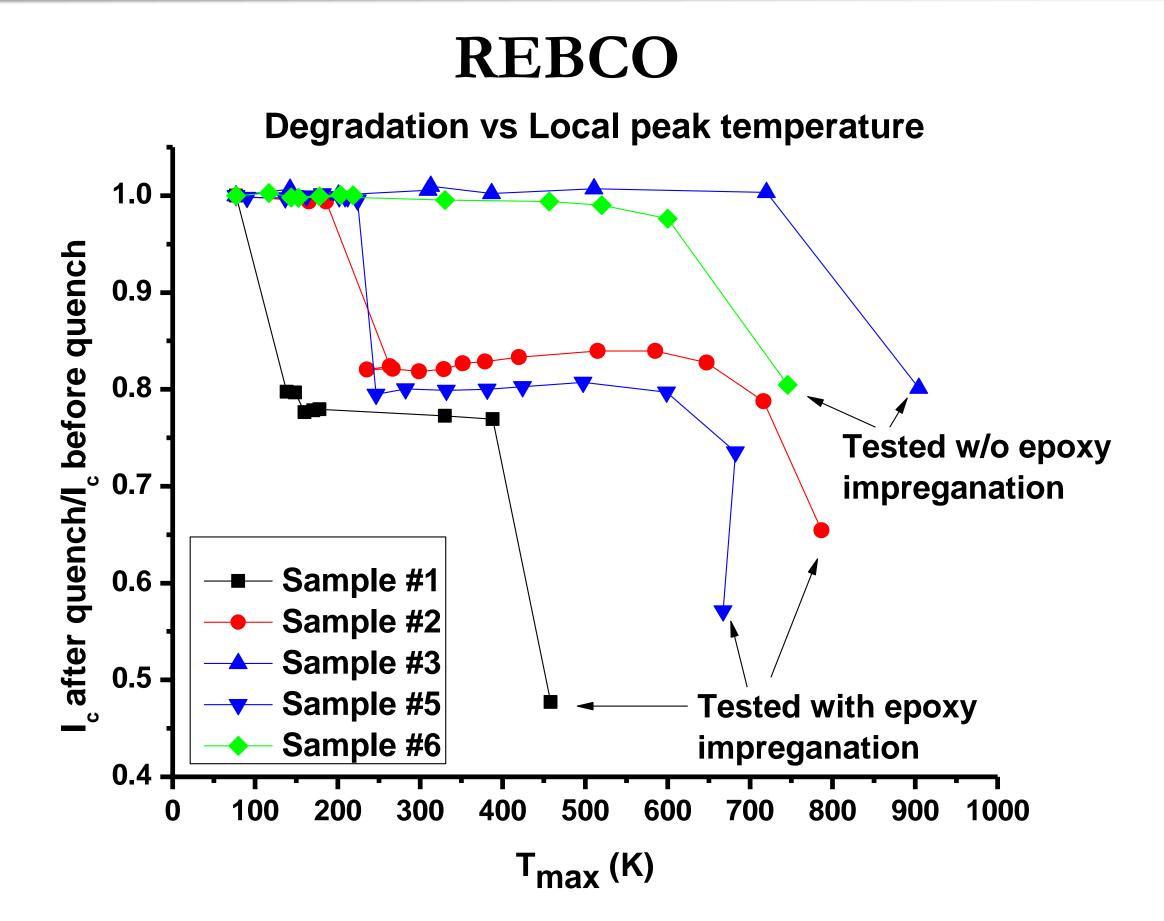
Liyang Ye<sup>1,2</sup>, Mattia Duranti<sup>3</sup>, Jason Wu<sup>3</sup>, Pei Li<sup>1</sup>, Justin Schwartz<sup>2</sup>, and Tengming Shen<sup>1</sup>

- 1. Fermi National Accelerator Laboratory, Batavia, IL 2. North Carolina State University, Raleigh, NC 3. Summer students visiting Fermi National Accelerator Laboratory
- Understanding quench degradation behavior and limits of REBCO and Bi2223 conductors is important for developing high-field magnet technology from these high field conductors.
- Through extensive heater-induced quench experiments and microscopic observation of degraded samples, this work shows: (1) For both REBCO and Bi2223, quench degradation is very localized and strongly depends on  $T_{\text{max}}$ , the local hot spot temperature during a quench; (2) Standalone REBCO coated conductors showed irreversible degradation when  $T_{\text{max}}$  exceeded 700 K whereas when impregnated with epoxy, REBCO tapes exhibited degradation at  $T_{\text{max}}$  as low as 140 K; (3) Early investigation showed Bi2223 powder-in-tube tapes can degrade at a  $T_{\text{max}}$  of 200 K. (4) Microscopic observation showed delamination in the degraded REBCO coated conductors and other degradation features including holes punctuating the tape.



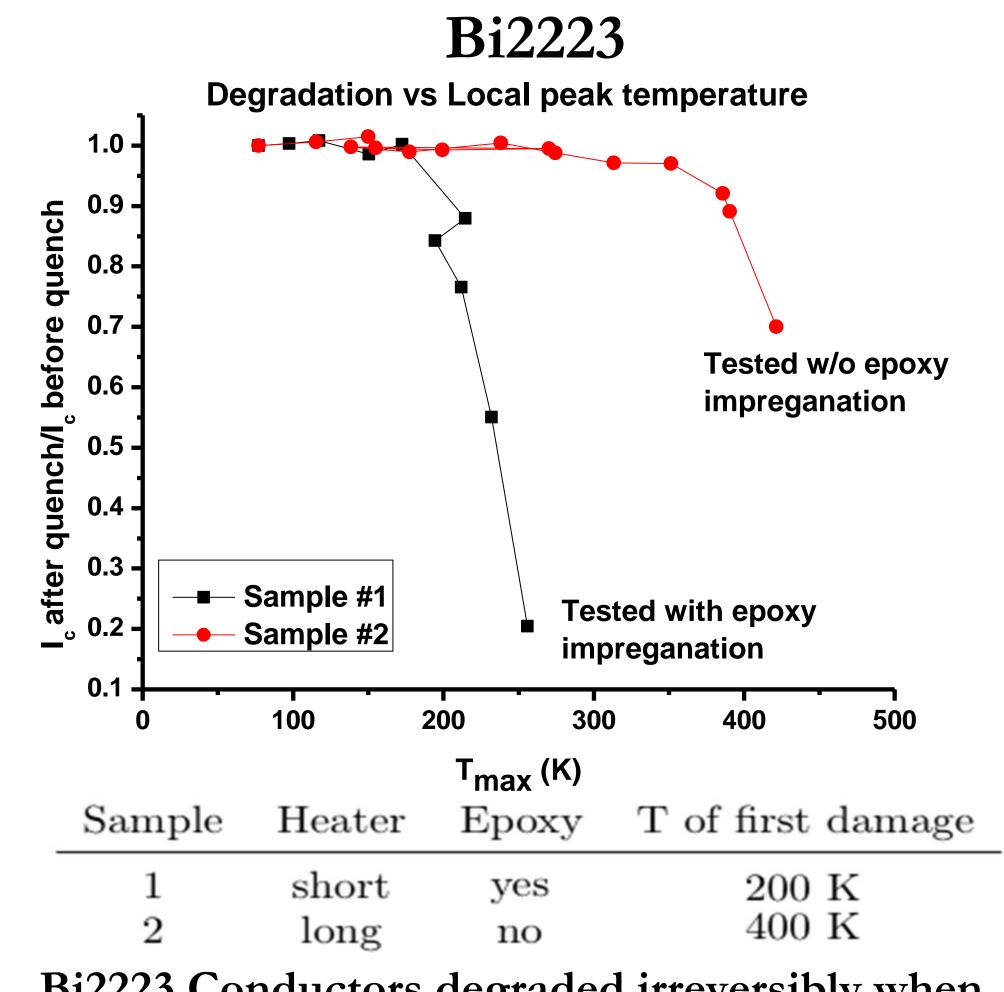


## $I_{\text{c\_degraded}}/I_{\text{c\_original}}$ – $T_{\text{max\_normal zone}}$ behaviors observed among REBCO and Bi2223

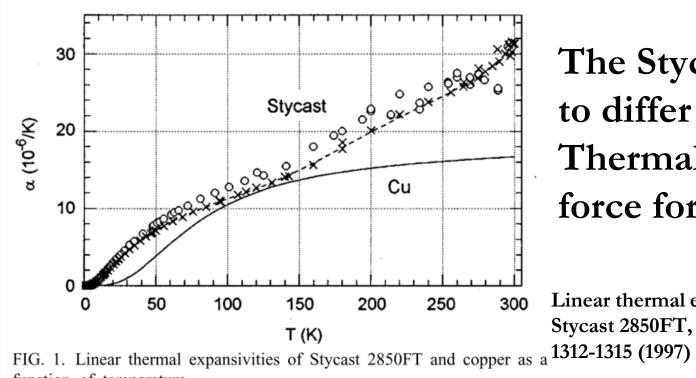


- REBCO Conductors degraded irreversibly when  $T_{\rm max}$  exceeded ~700K.
- Epoxy (Stycast 2850) impregnated REBCO samples showed early degradation with  $T_{\rm max}$  as low as 140 K.

Sample	Heater	Epoxy	T of first damage
1	short	yes	140 K
2	long	yes	280  K
3	long	no	850  K
4	flat	no	
5	long	yes	270  K
6	long	no	750  K



- Bi2223 Conductors degraded irreversibly when  $T_{\rm max}$  exceeded ~400K.
- Early degradation occurred with epoxy impregnated Bi2223 samples as well, with  $T_{\rm max}$  as low as 200 K.



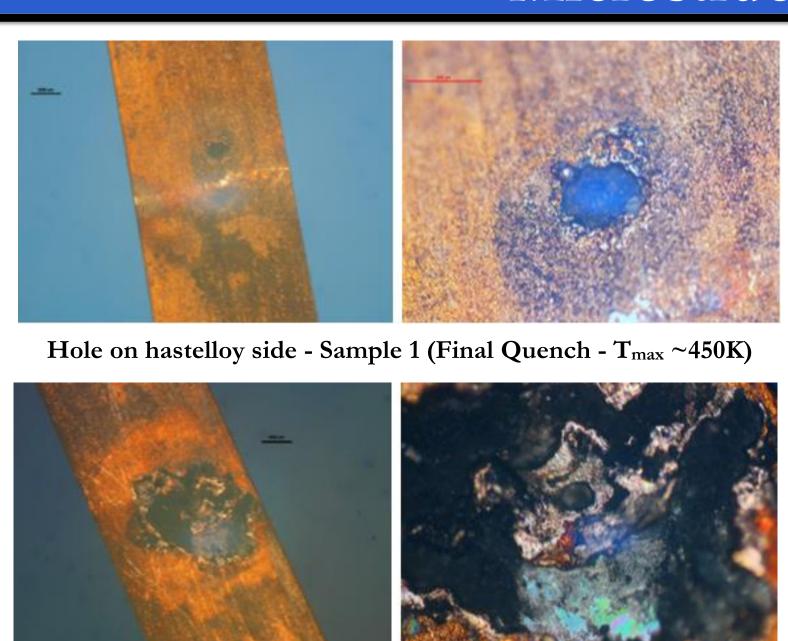
The Stycast's thermal expansion starts to differ from metals around 150 K. Thermal stress could be the driving force for the early degradation.

T (K)

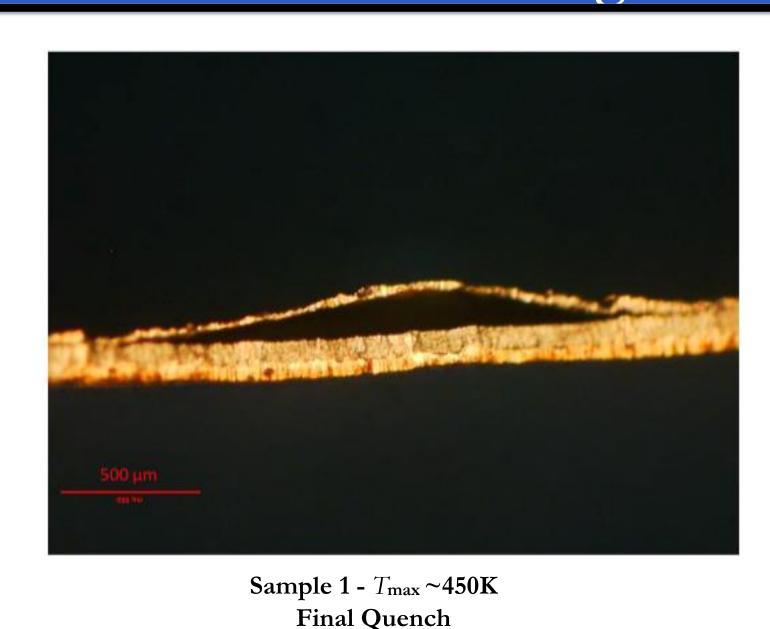
Stycast 2850FT and copper as a 1312-1315 (1997)

Linear thermal expansivity (1.5–300 K) and heat capacity (1.2–90 K) of Stycast 2850FT, Swenson, C. A., Review of Scientific Instruments, 68, 1312-1315 (1997)

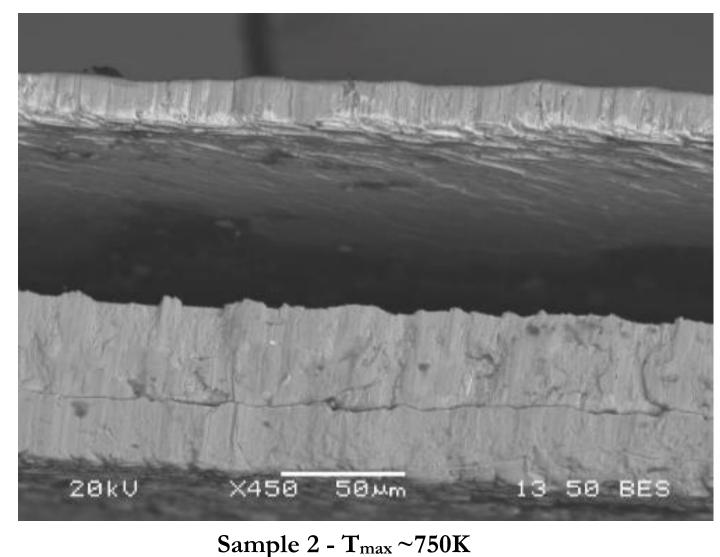
## Microstructure observation of the Degraded REBCO Samples



Hole on REBCO side - Sample 1 (Final Quench -  $T_{max} \sim 450K$ )



Delamination of Cu-Ag layer from REBCO layer



Sample 2 - T<sub>max</sub> ~750K

Final Quench

Delamination of Cu-Ag layer from REBCO layer