

# Effects of Cu and transverse-stress fatigue on the electromechanical properties of slitted YBCO Coated conductors

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# Outline

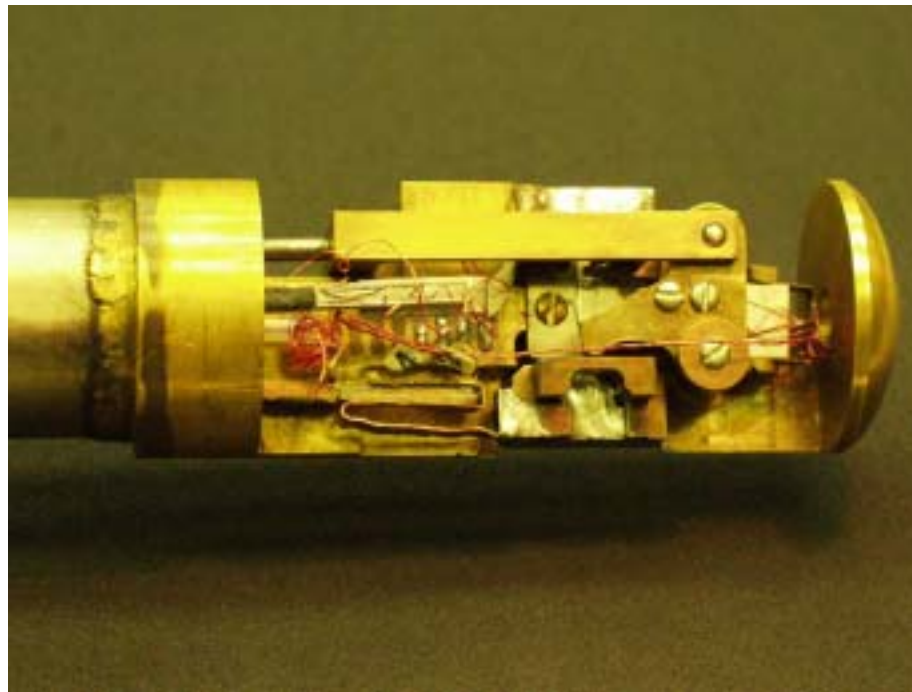
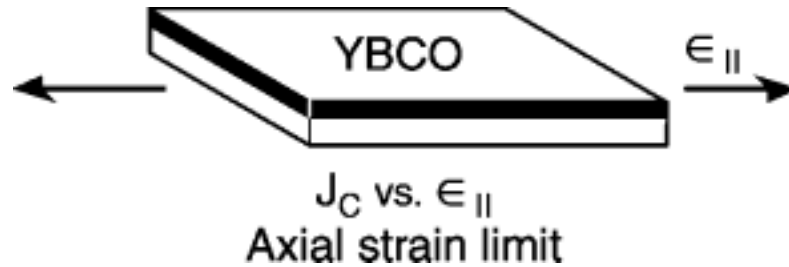
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- **Cu stabilization:** Effect of Cu-lamination and Cu-plating on the irreversible axial-strain limit (76 K and self-field)
- **Fatigue testing:** Effect of transverse-compressive-stress fatigue on slitted YBCO coated conductors (76 K and self-field)



# $J_c$ vs. Axial-strain measurements

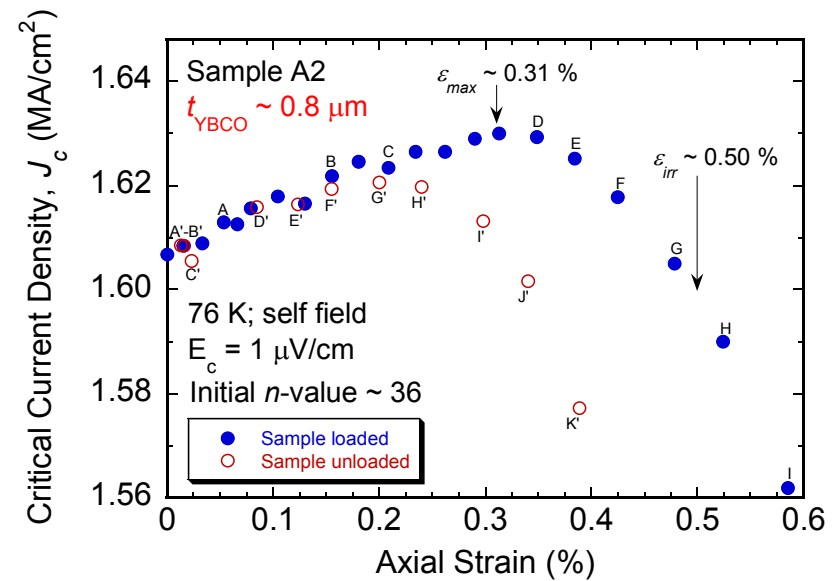
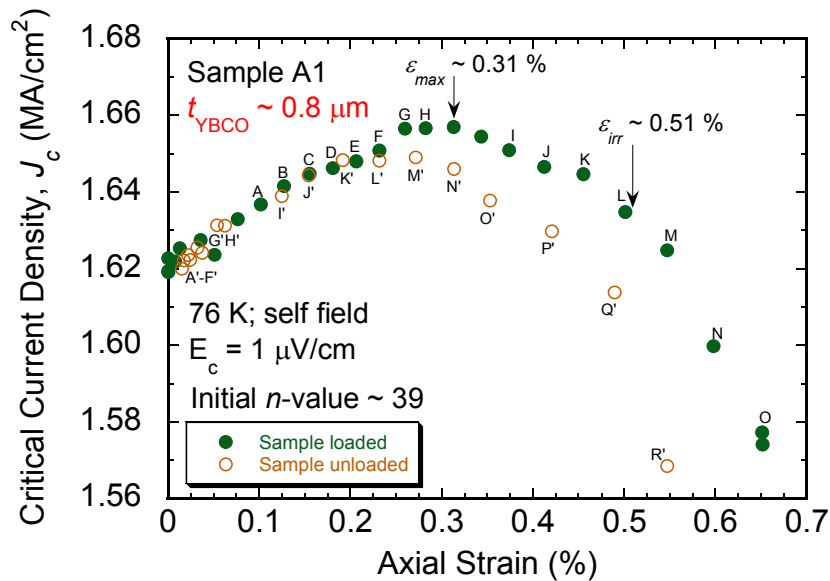


Samples cooled in a **Stress-free** manner

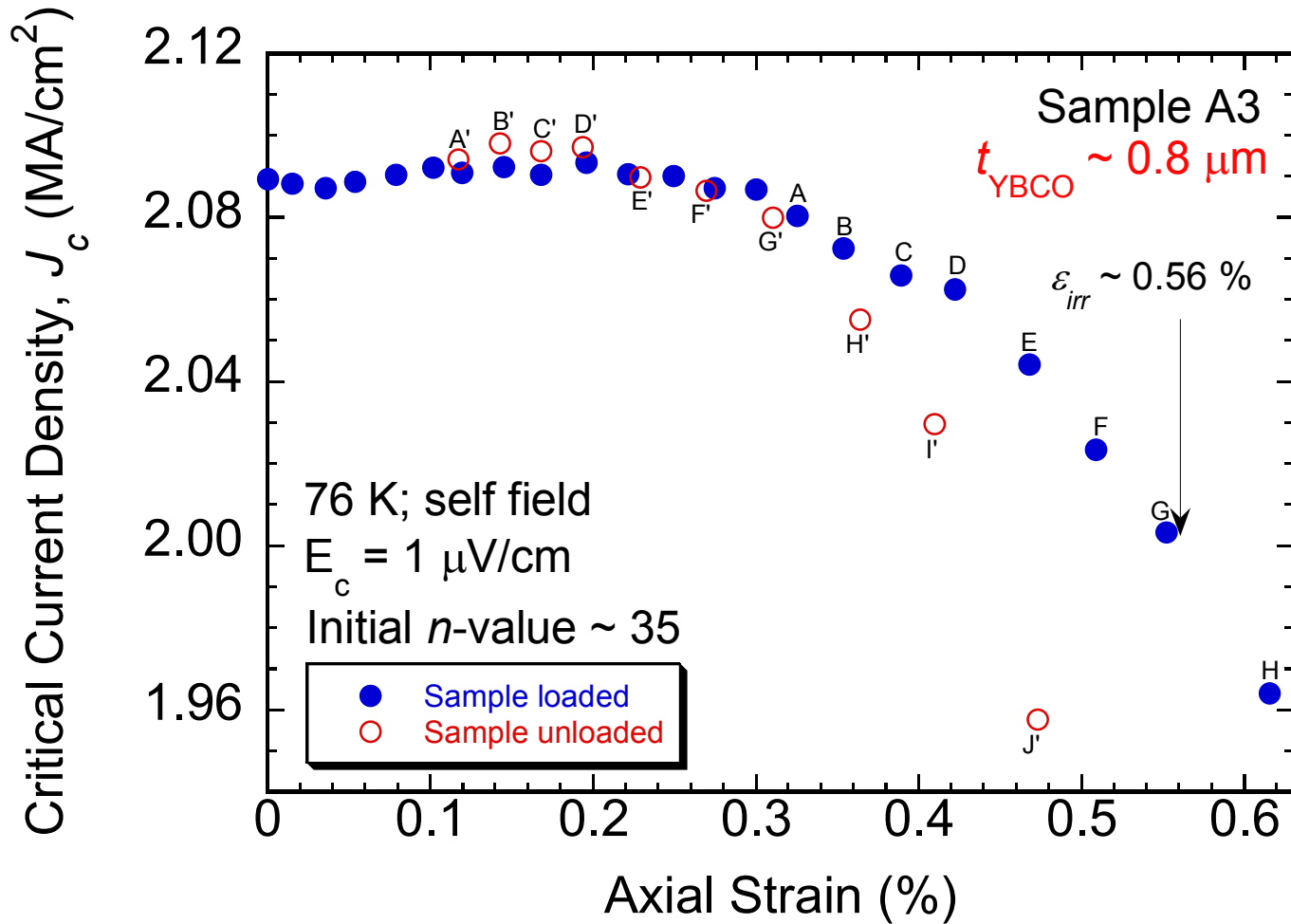


# AMSC Neutral-axis RABiTS conductor: (Cu/Ag/YBCO/Ni-5at.%W)

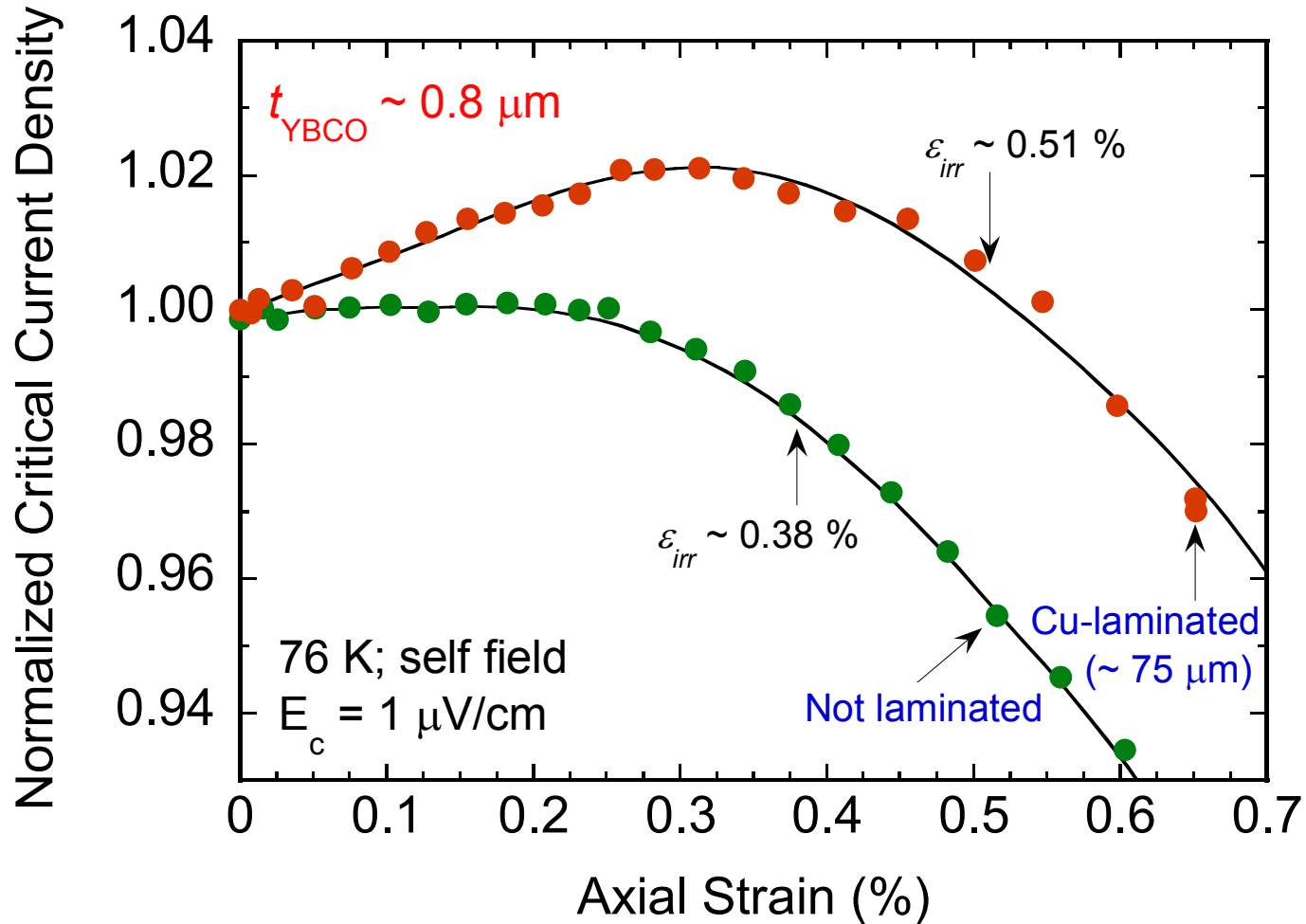
$J_c$  vs. axial strain at 76 K & Self-Field



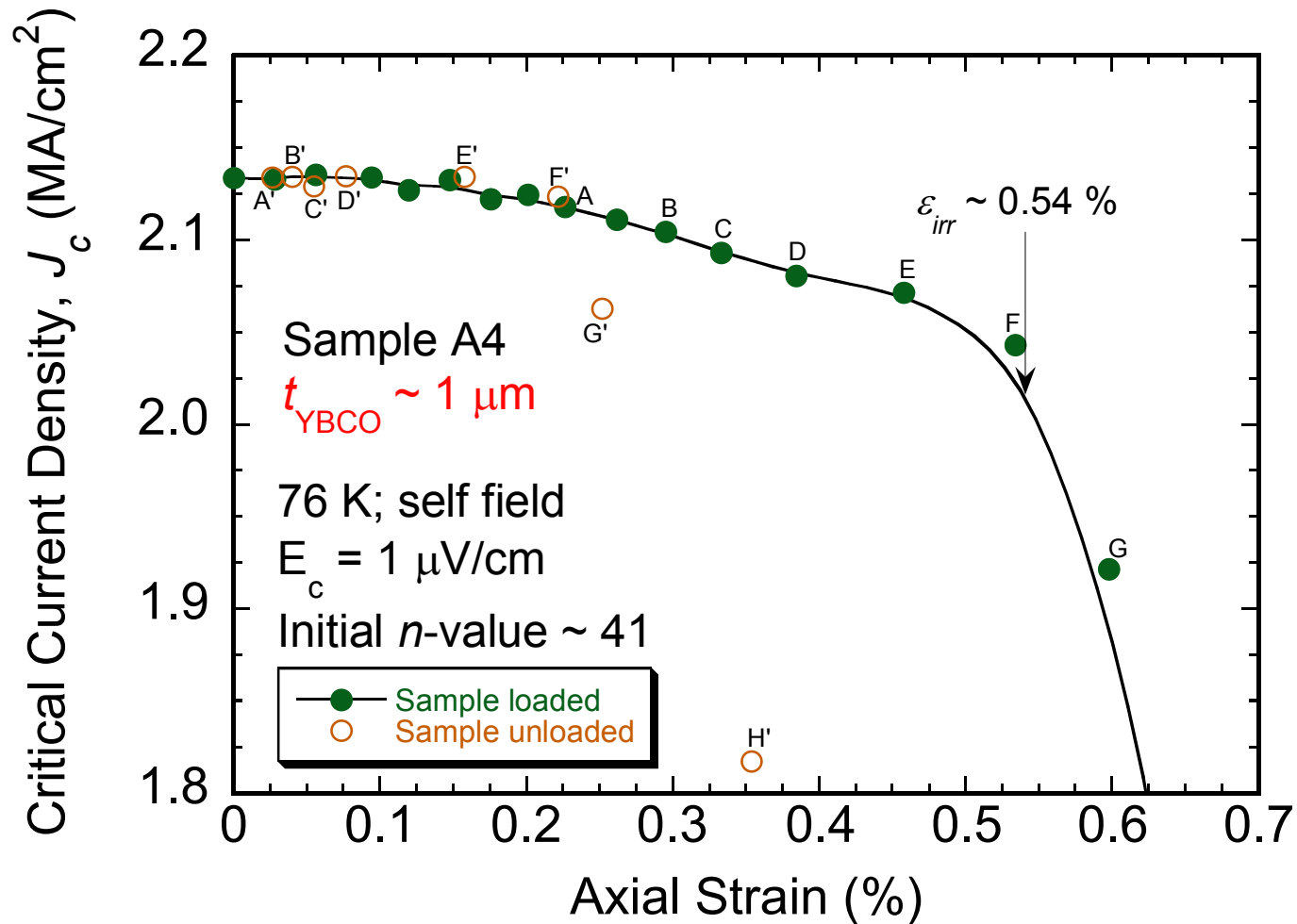
# AMSC Neutral-axis RABiTS conductor: (Cu/Ag/YBCO/Ni-5at.%W)



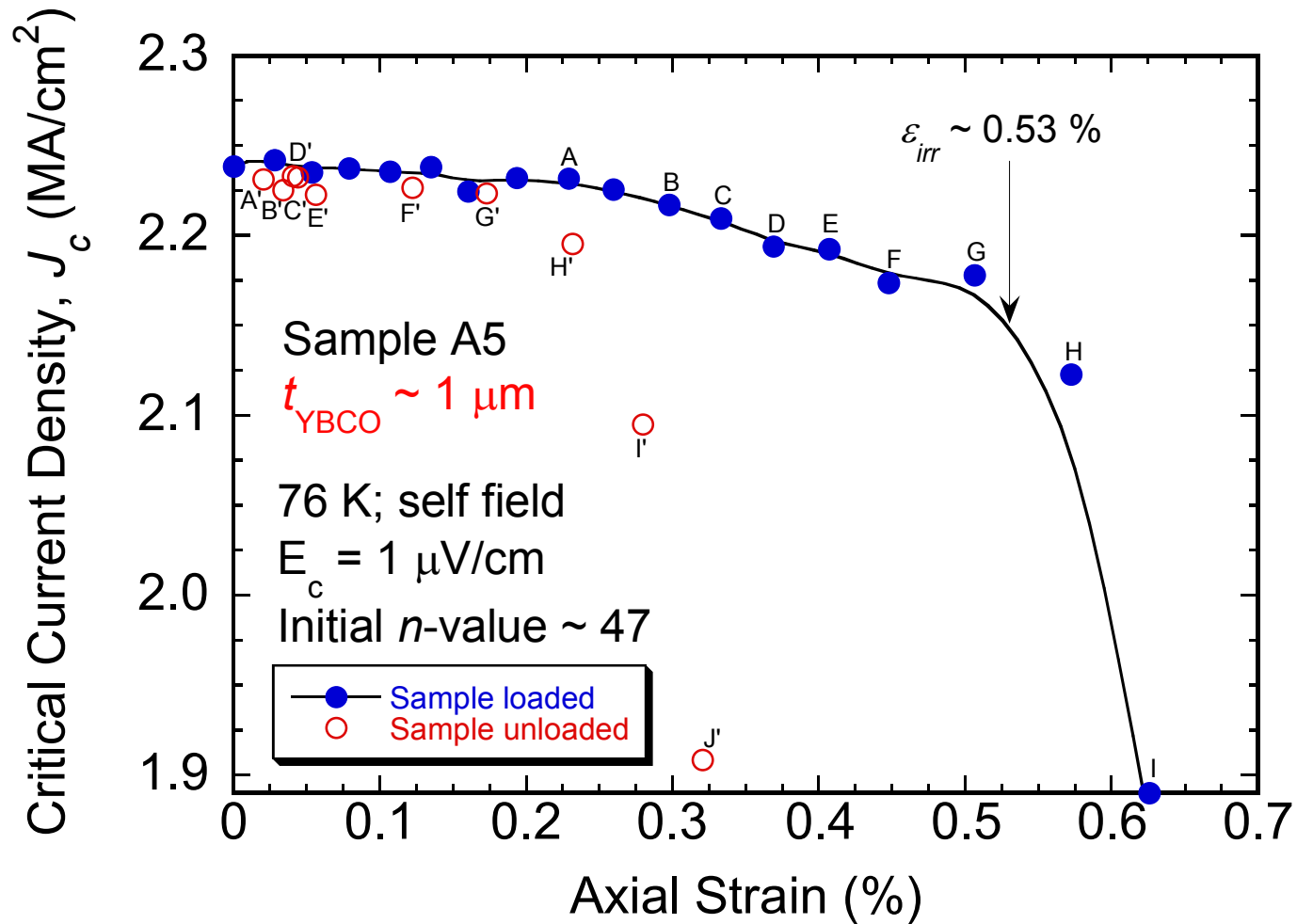
# AMSC Neutral-axis RABiTS conductor: Effect of Cu-lamination on $\epsilon_{irr}$



# SuperPower Cu-Plated IBAD conductor: (Cu/Ag/YBCO/Hastalloy C-276)-one side Cu-plating

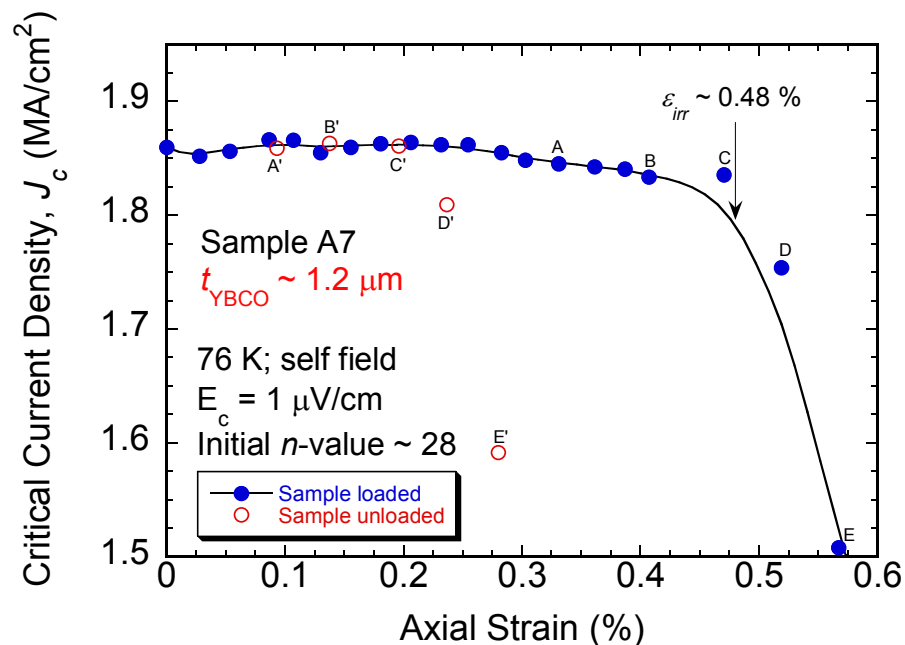
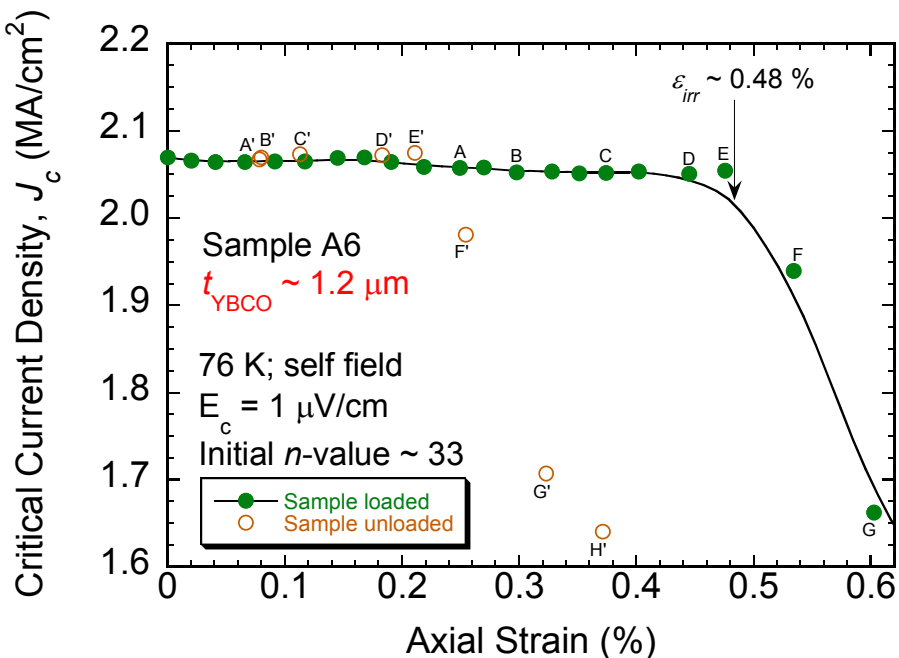


# SuperPower Cu-Plated IBAD conductor: (Cu/Ag/YBCO/Hastalloy C-276)-one side Cu-plating

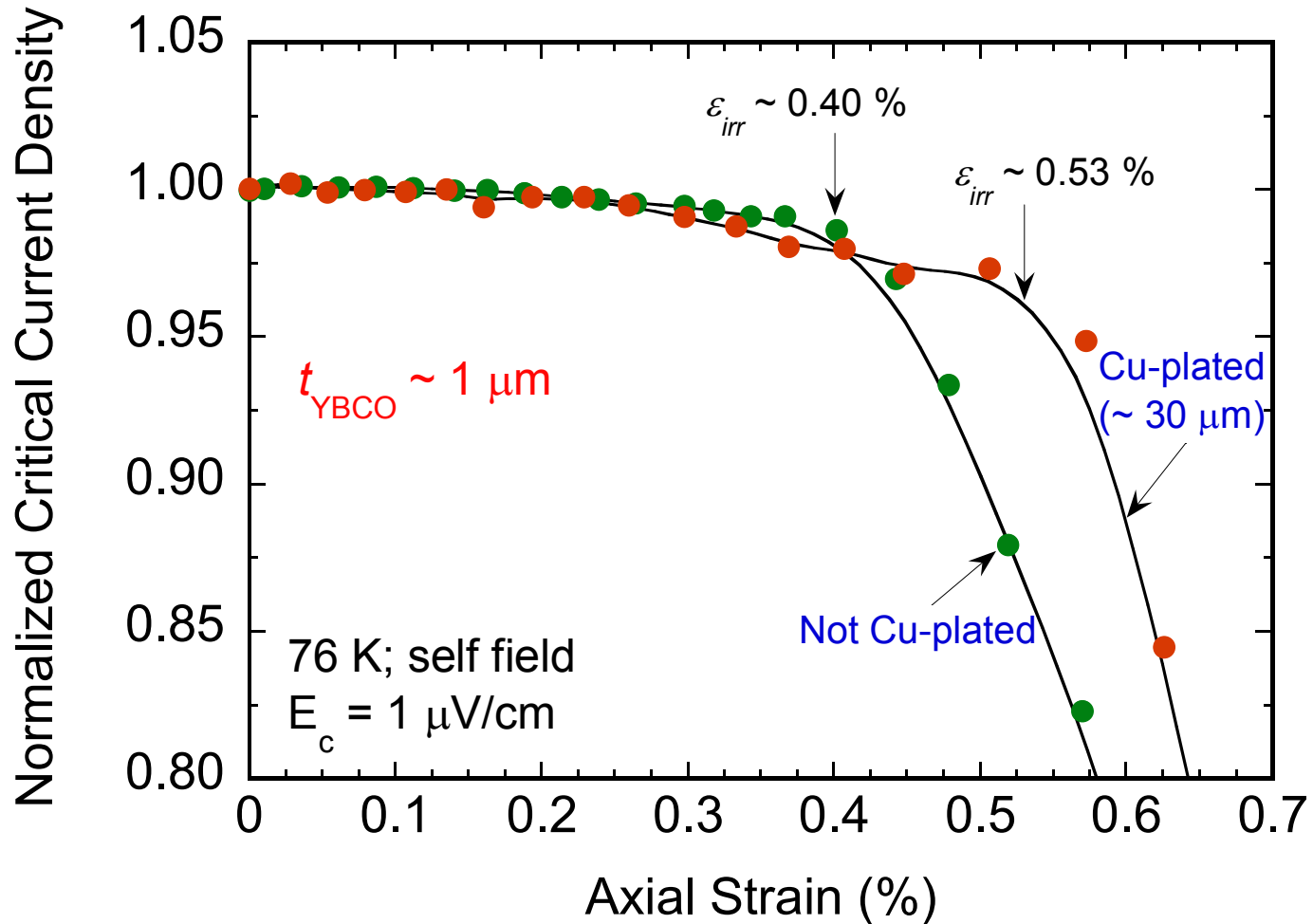


# SuperPower Cu-Plated IBAD conductor: (Cu/Ag/YBCO/Hastalloy C-276)-all sides Cu-plating

Total Cu-thickness  $\sim 30 \mu\text{m}$ , similar to one-side Cu-plated samples



# SuperPower Cu-Plated IBAD conductor: Effect of Cu-plating on $\epsilon_{irr}$



# Effect of Cu stabilization layer: Summary/Impact

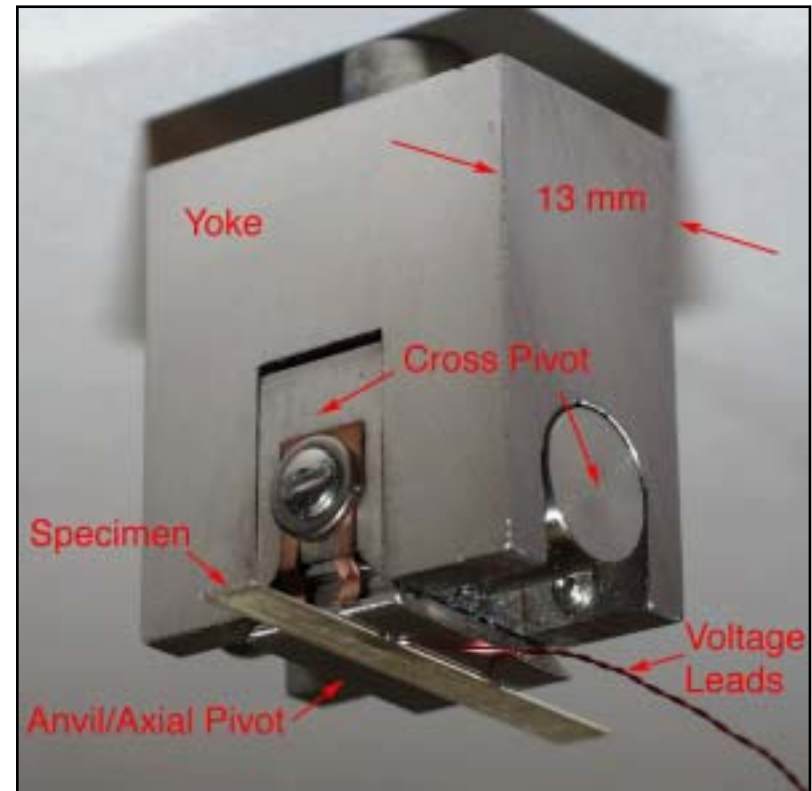
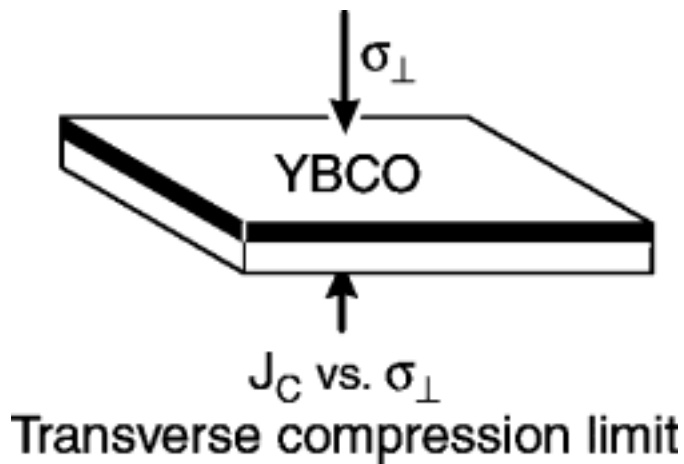
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- Irreversible strain  $\epsilon_{irr} \sim 0.48 - 0.56\%$ , higher than  $\epsilon_{irr}$  values obtained for non-Cu stabilized IBAD and RABiTS conductors
- Cu layer probably exerts **pre-compressive strain** on YBCO film during cool-down from processing temperatures to 76K, **beneficial** for extending  $\epsilon_{irr}$
- Possibly, Cu layer may also act as crack arrester
- Axial-strain performance of **Cu-laminated** and **Cu-plated** YBCO RABiTS and IBAD comfortably **meet the most severe benchmarks for applications**
- **Optimization** of Cu-layer thickness?

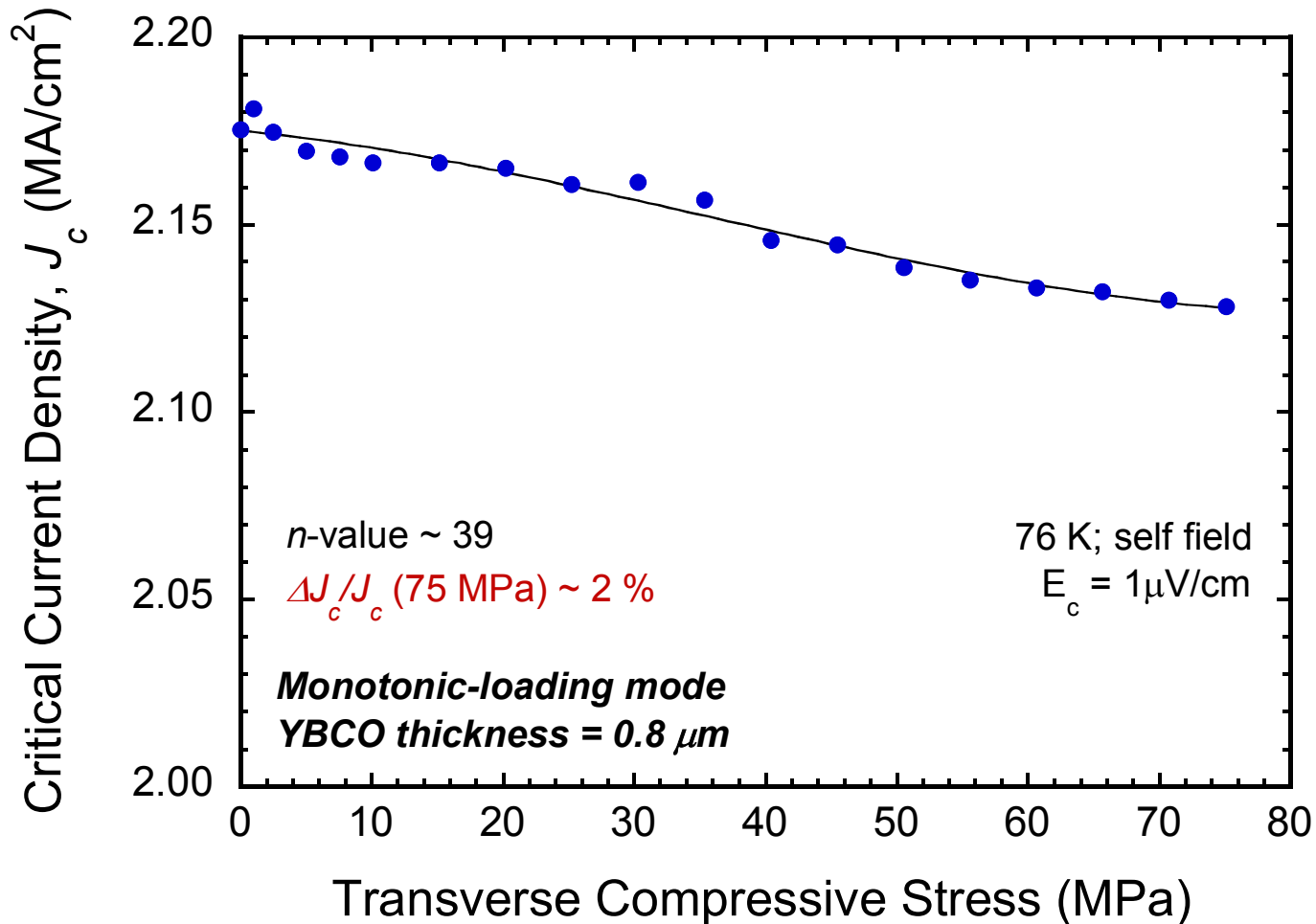


# Transverse Compressive Stress and Fatigue measurements: Evaluation of Slitting

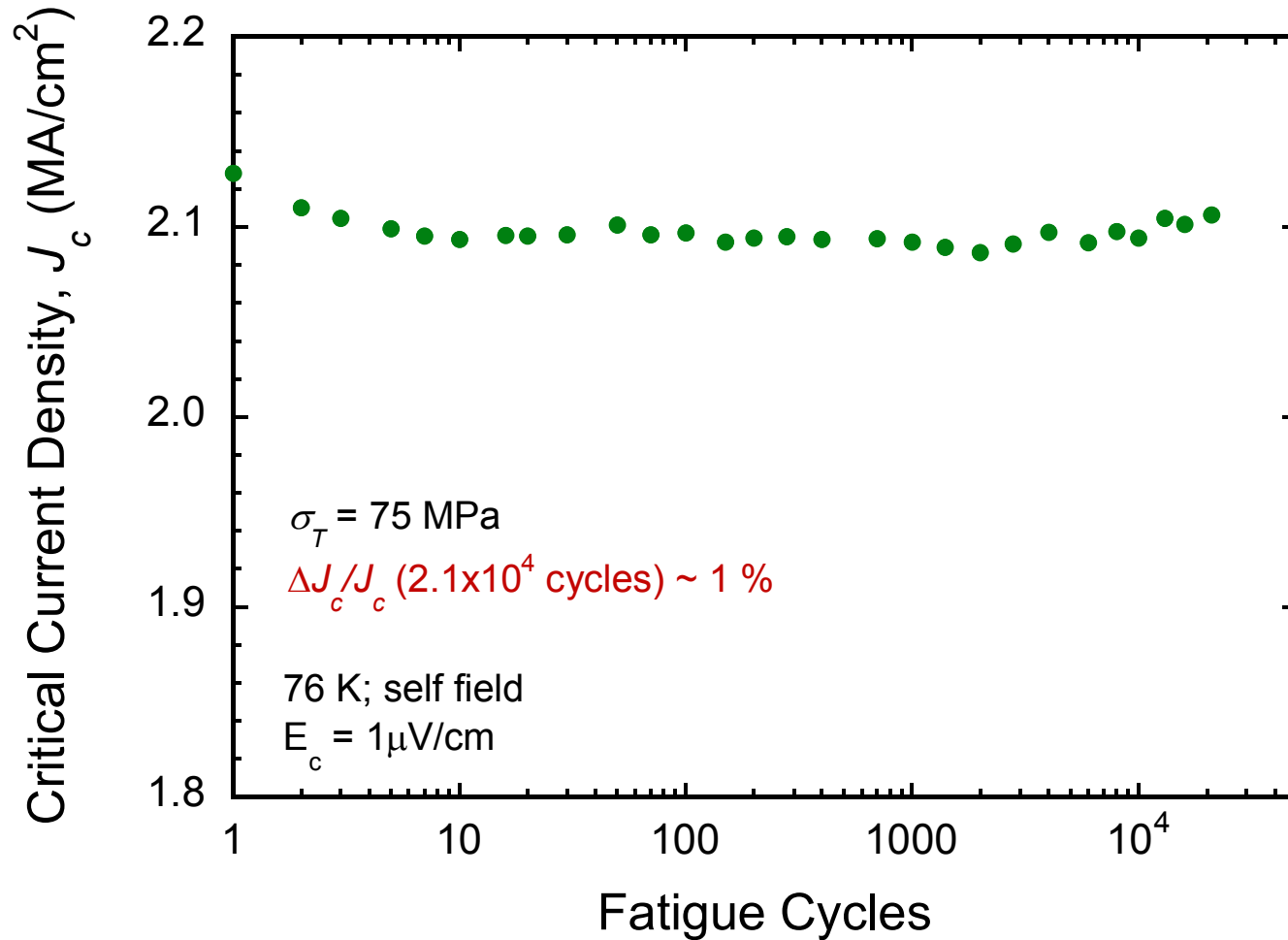
## Transverse-stress test fixture



# AMSC Neutral-axis RABiTS conductor: $J_c$ vs. Transverse Compressive Stress



# AMSC Neutral-axis RABiTS conductor: Fatigue Cycles ( $2.1 \times 10^4$ ) at $\sigma_T = 75$ MPa



# Fatigue testing: Summary/Impact

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- Transverse-stress fatigue cycles could be used to discriminate between different **tape-slitting techniques**
- What transverse-compressive-stress level will the conductor experience in real applications? Preliminary measurements performed at **75 MPa**: **Too low? Adequate?**
- What number of fatigue cycles will the conductor be subjected to? Preliminary measurements performed up to  **$2.1 \times 10^4$  cycles**: **Too low? Adequate?**
- Feedback from industrial and research partners required on these questions

