

I_c survival of the delaminated coated conductor and its potential application in superconducting joint

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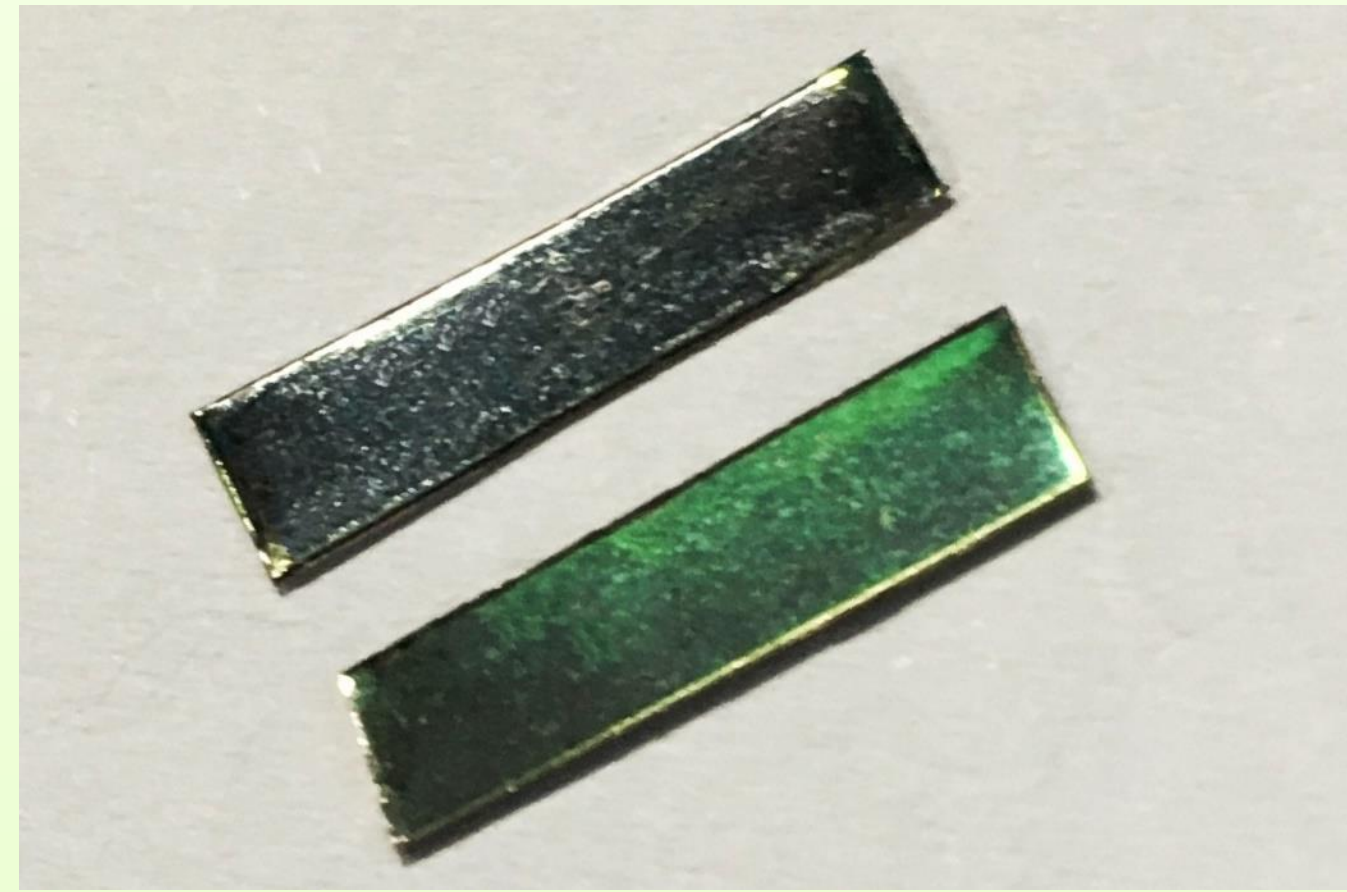
ABSTRACT

It is well known that coated conductor (CC) could be easily delaminated because of its poor stress tolerance in thickness direction, i.e. along the c -axis of YBCO. Commonly, the delaminated CC is considered to be destroyed. In this study, a CC sample fabricated via the MOD (metal-organic deposition) route was delaminated by liquid nitrogen immersing. A Hall probe scanning system was employed to measure the I_c distribution of the original sample and the delaminated stack. It was found that I_c could be partially preserved (~50%) after the delamination. Dense and crack-free morphologies of the delaminated surfaces were observed by scanning electron microscopy (SEM). X-ray diffraction (XRD) and SEM measurements both revealed that delamination occurred near the YBCO-CeO₂ interface, and BaCeO₃ might be the reason for the degraded adhering strength. The delaminated stack of YBCO/silver/copper architecture could be considered as a new type of CC with the silver stabilizer as its buffer layer, which is quite different from the oxide buffer layers in the traditional CC. The potential application of delaminated stack for superconducting joint technology was discussed based on the estimation of oxygen diffusion, and a short oxygenation duration could be expected.

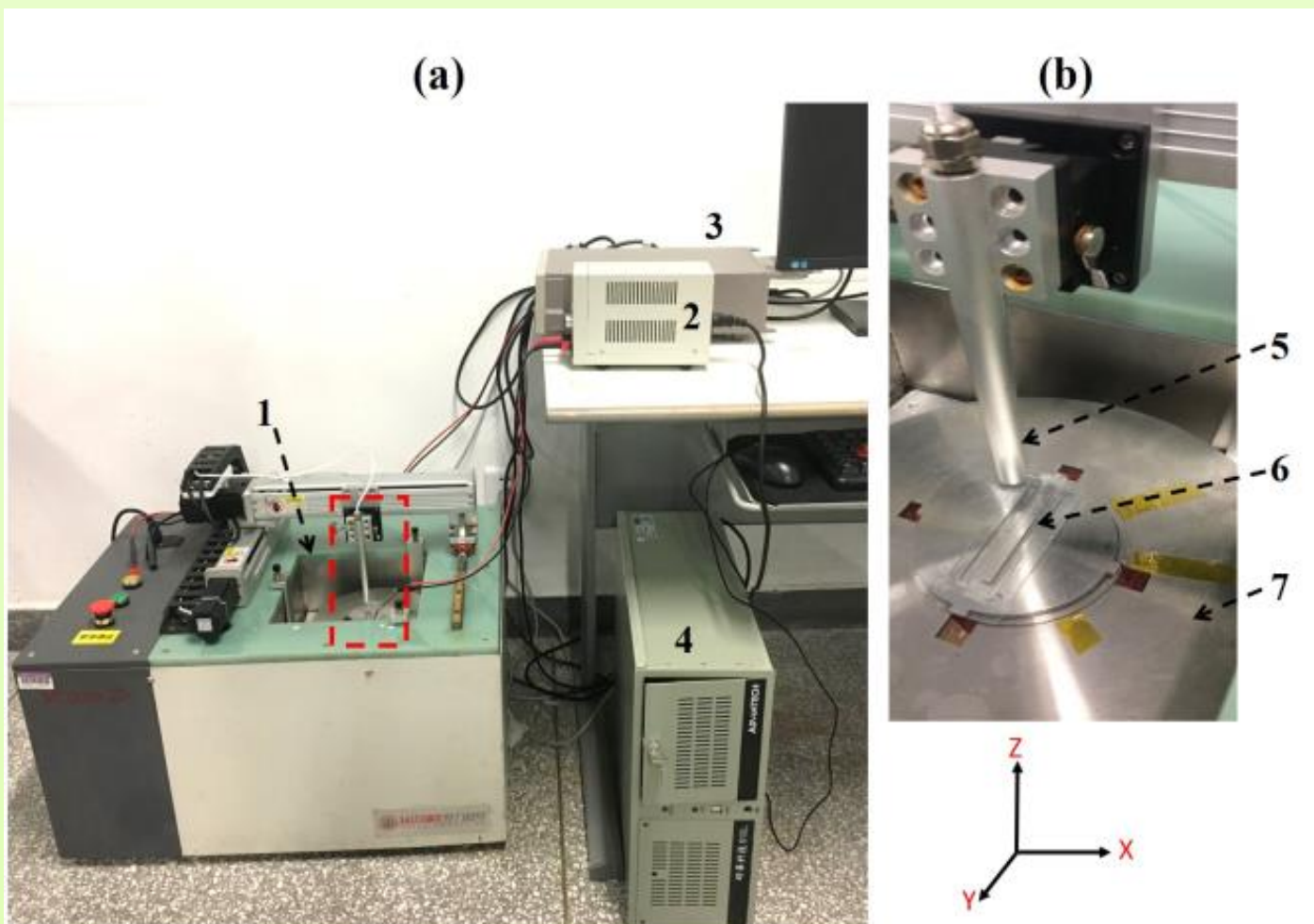
1. INTRODUCTION

- Delamination is generally regarded as CC failure and a severe threat for HTS practical applications.
- In the thickness direction, adhesion strength of layer interfaces is weak, which could lead to delamination.
- There was a very long duration of oxygenation process to fabricate the superconducting joint for CC.

2. EXPERIMENT

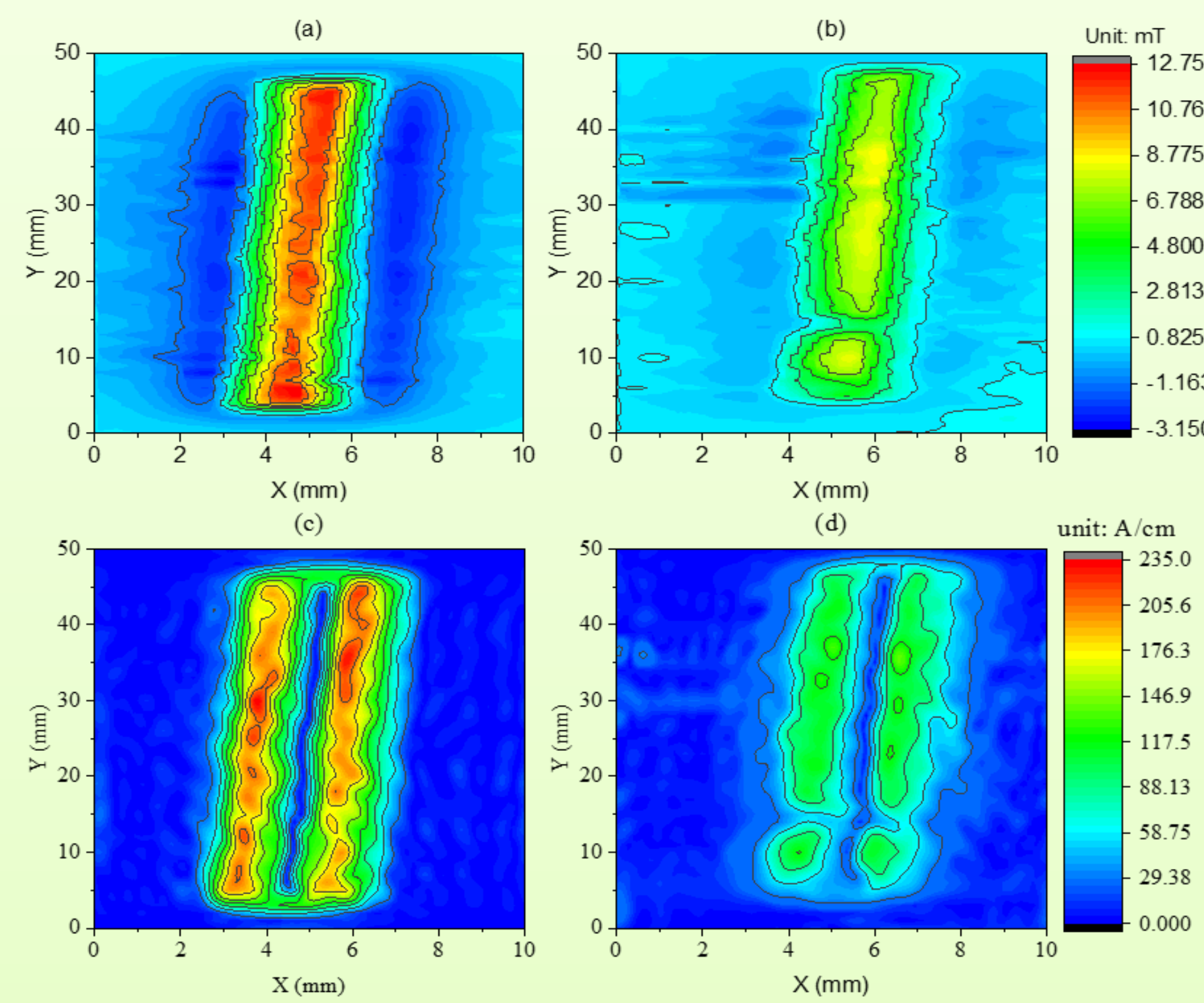


Delamination picture of a CC sample fabricated via MOD route after liquid nitrogen immersing. The upper one was the delaminated sample with YBCO layer, the other with buffer layer.

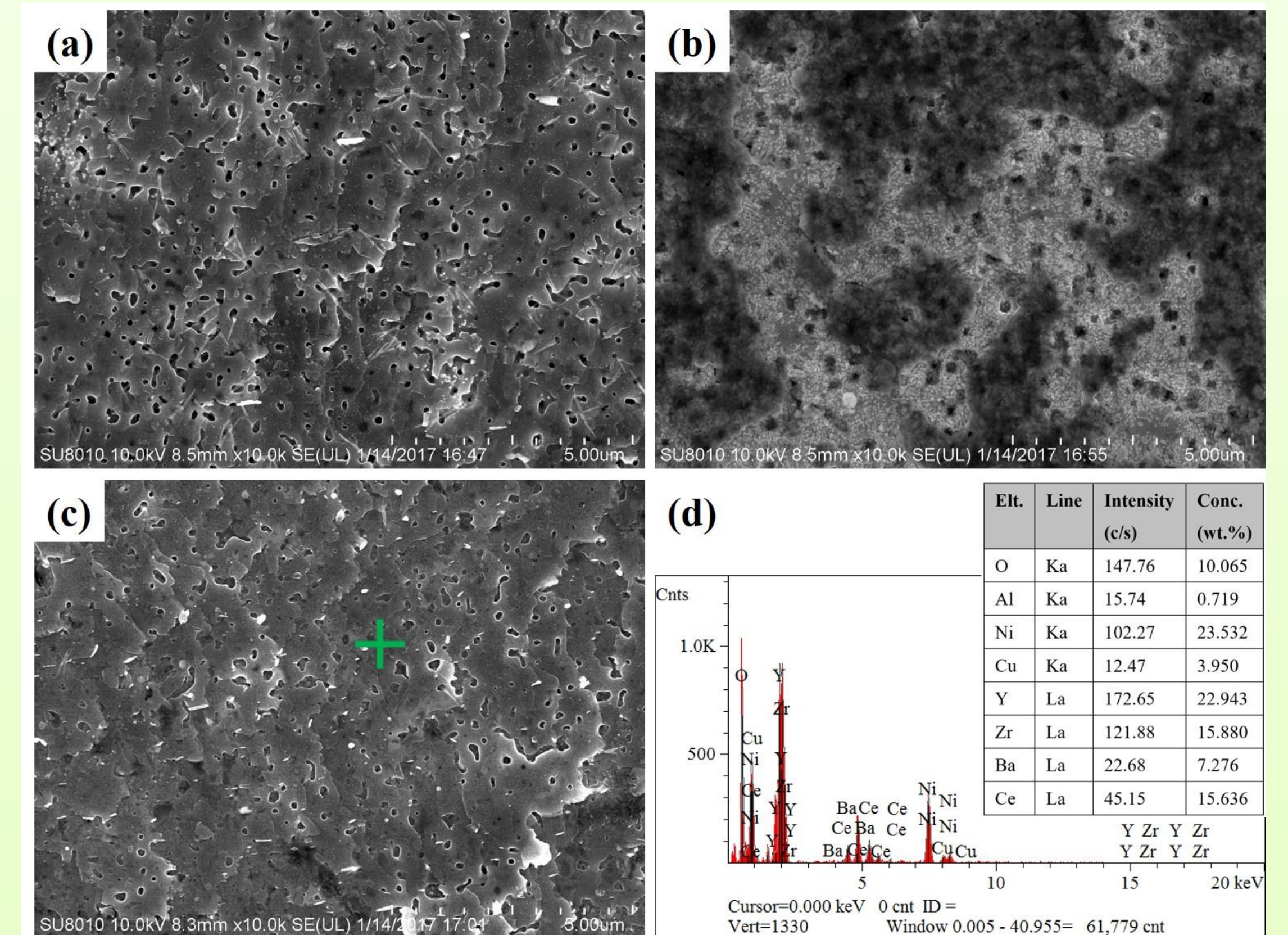


The Hall probe scanning system for I_c distribution measurement. 1 Liquid nitrogen pool, 2 DC source exciting magnet, 3 Keithley 2700, 4 Computer, 5 Hall probe, 6 Measured sample, 7 Exciting magnet of copper coil.

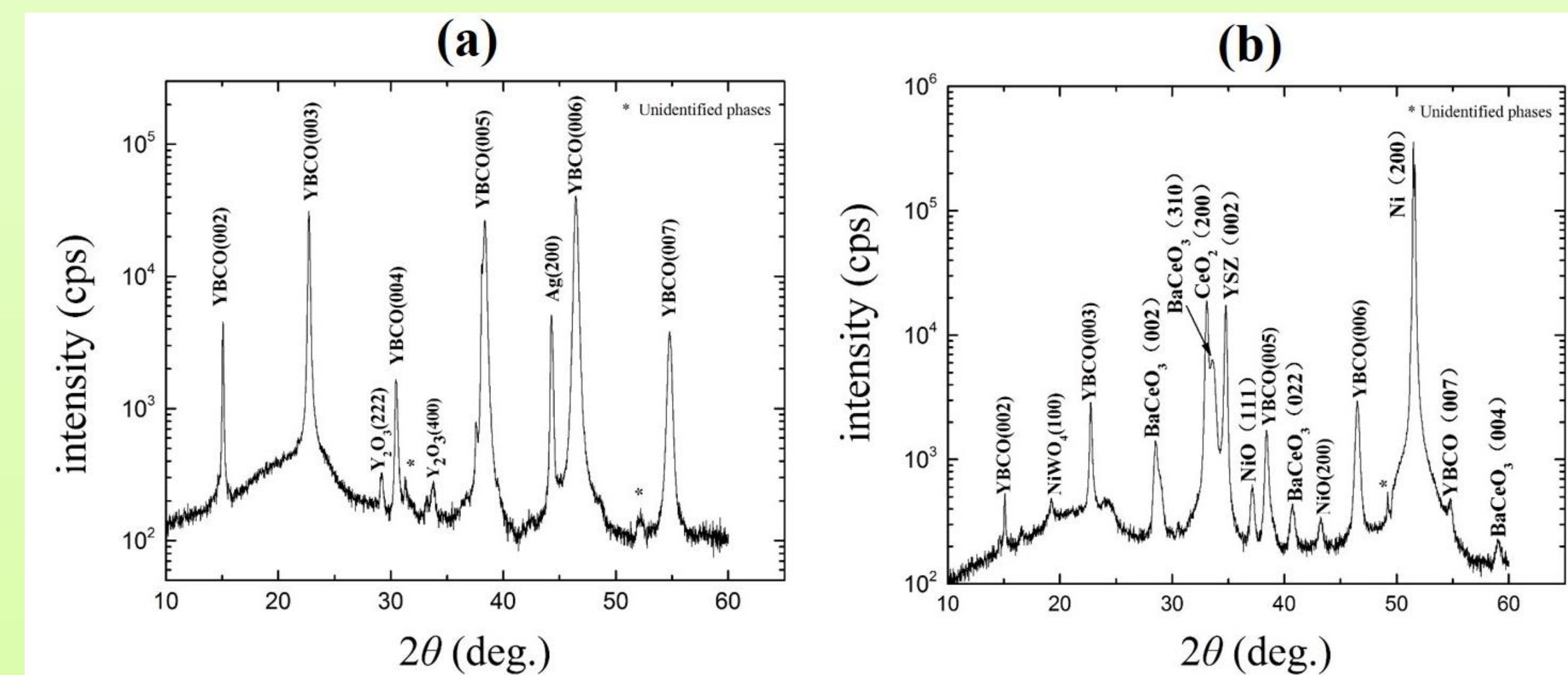
3. RESULTS AND DISCUSSION



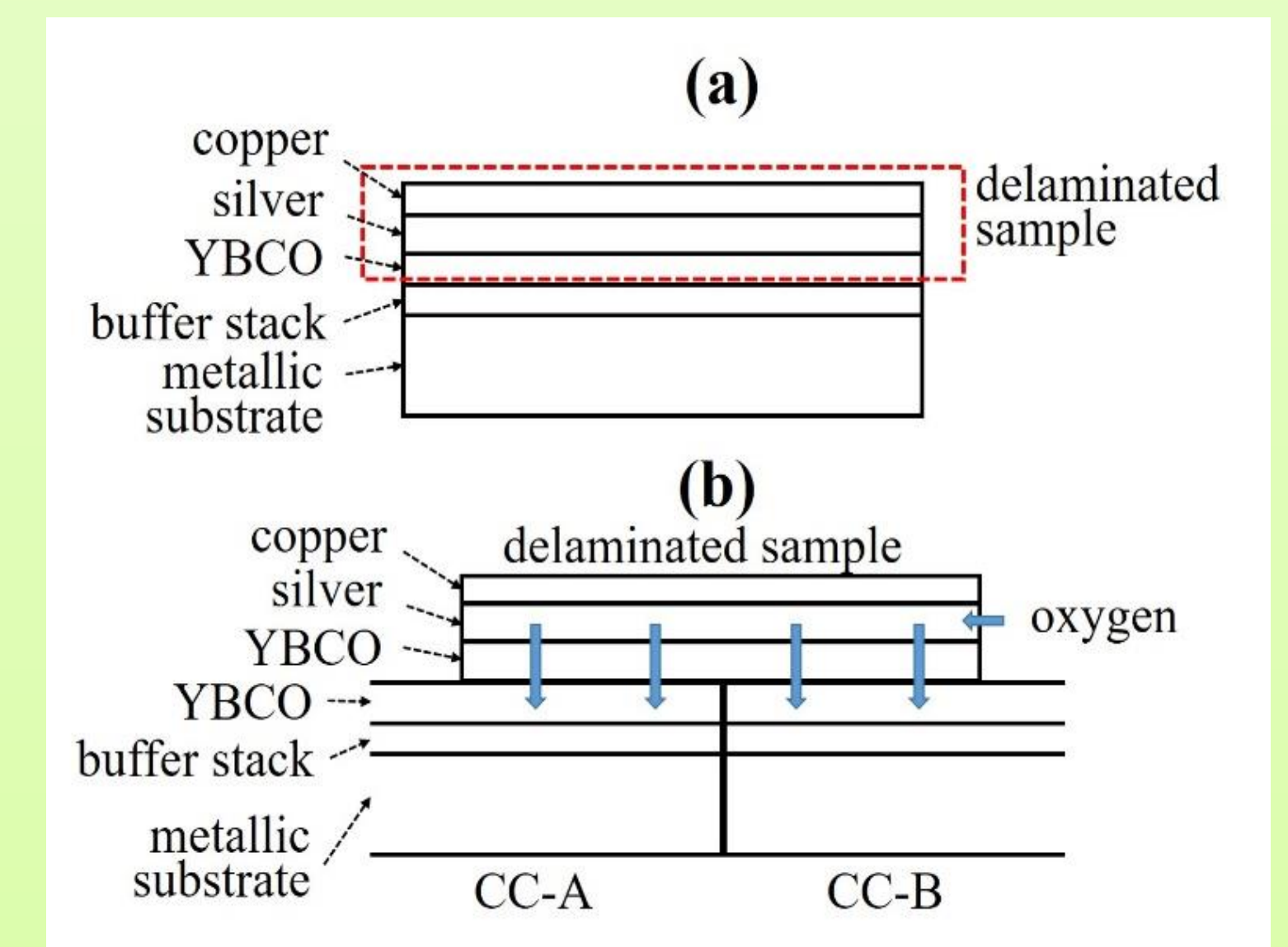
B distributions: (a) the original sample, (b) the delaminated sample. I_c distributions: (c) the original sample, (d) the delaminated sample.



SEM images: (a) zone with preserved I_c , (b) zone with zero I_c of delaminated sample, (c) the delaminated part with buffer layers, (d) EDS result at the cross position.



XRD patterns: (a) the delaminated sample with YBCO layer, (b) the delaminated part with buffer layers.



(a) original and delaminated sample, (b) potential superconducting joint.

4. CONCLUSION

- I_c could survive in the delaminated sample, with about 50% preserved percentage relative to the original sample. SEM and XRD indicated that delamination occurred inside the YBCO layer and near the YBCO-CeO₂ interface.
- In MOD-YBCO fabrication, BaCeO₃ could be formed easily, and the epitaxial relationship between BaCeO₃ and YBCO was not favorable. Therefore, the fact that delamination occurred near the YBCO-CeO₂ interface might be attributed to the degraded adhering strength caused by BaCeO₃.
- Silver owned a oxygen diffusion coefficient of 10^{-6} cm²/s at 450~600° C (a typical temperature range for the oxygenation process of YBCO), which is much larger than YBCO (typically 10^{-14} cm²/s in c -axial direction).
- The delamination behavior of CC might be a beneficial factor with new application potential.