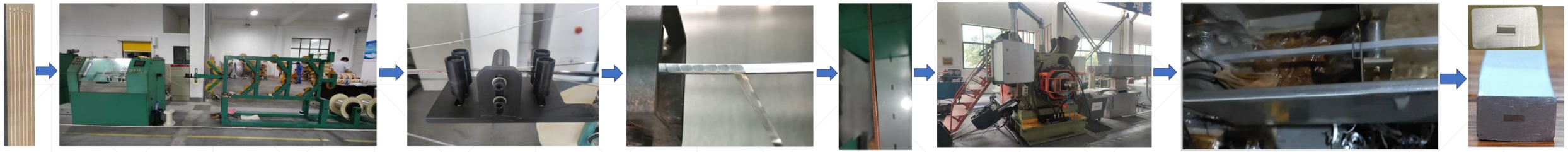
Manufacturing Process



YBCO tapes | Wrapping machine | limit fixation | wrapping process (video) | YBCO stack | Extrusion machine | cooling | ASTC

- **Wrapping.**

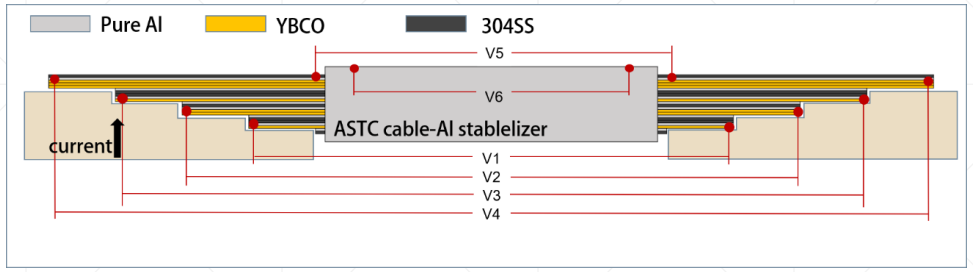
80 μm thick, 4 cm wide superconducting tapes and aluminum tapes or other metal tapes of the same specification are stacked in order, and 20-23 tapes can be accommodated according to the size of the mold. A layer of pure aluminum with a thickness of 0.5/0.4 mm is added on the upper and bottom surfaces of the superconducting stack to protect the superconducting stack, and its lower elastic modulus is used as a stress buffer layer. Use a thin metal (copper or aluminum) tape with a thickness of 80 μm, wrap it around the superconducting stack, and bind it to fix it.

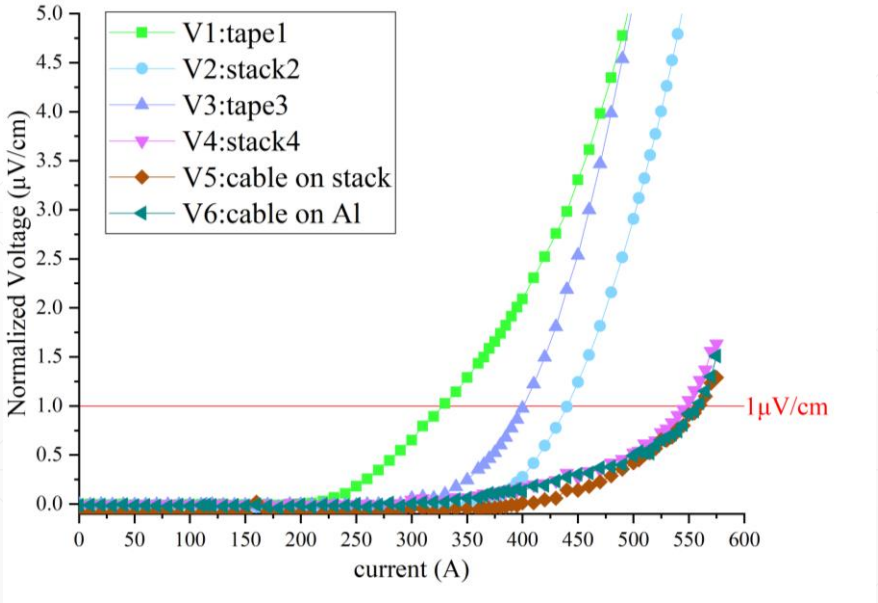
- **Co-extrusion.**

Co-extrusion technology means that aluminum is melted by the friction provided by the extrusion wheel and then extruded through the mold export. In this process, the ReBCO tape will inevitably enter the dangerous environment of high temperature and complex stress. In the previous study, it has been verified 400-450℃ is a relatively safe and reasonable co-extrusion temperature. By providing cooling water, the high temperature is controlled for a duration of less than 3s. It is also necessary to adjust the parameters of the extruder equipment in order to balance the stress in the cable forming process as much as possible.

Experiment

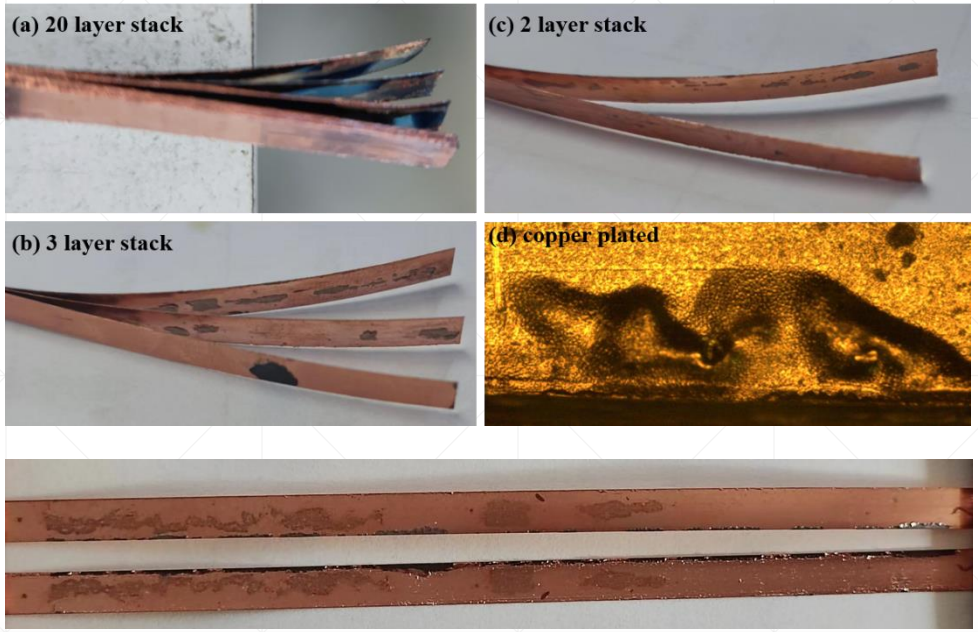
- Mill the aluminum at both ends and weld the core wire on the current lead in a stepped shape, with the YBCO facing down.
- f the cable is monitored by a voltage tap V5 welded onAfter ordering each superconducting stack/tape from bottom to top, weld voltage taps V1-V4. The critical current o the superconducting stack and a voltage tap V6 crimped on the outer surface of the cable, respectively.
- Both V5 and V6 reach the quench criterion at 560A, which proves that the voltage tap crimped to the aluminum stabilizer can accurately measure the cable critical current, and the aluminum stabilizer can share the current in a timely manner.

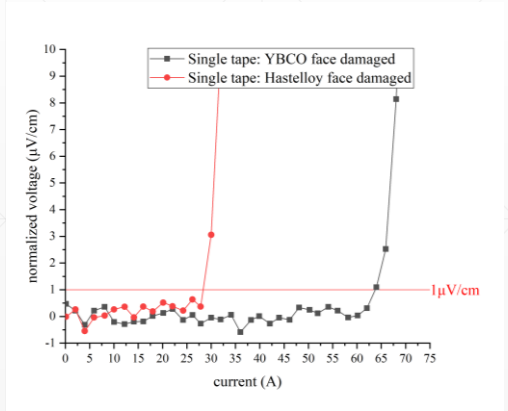


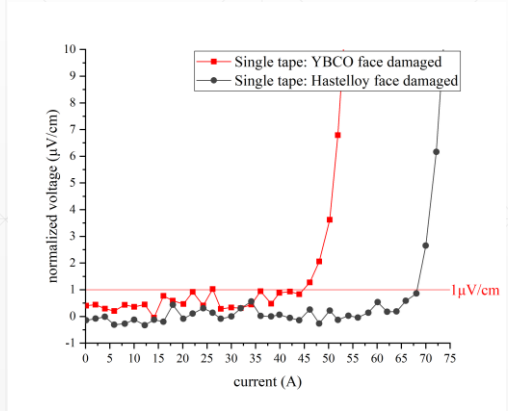


Adhesion of the copper plating

- In the course of the experiment, it was found that the adjacent copper plating layer of YBCO tape would happen adhesion phenomenon.
- This phenomenon seems to be related to the number of superconducting layers: the more superconducting layers, the more adhesions.
- Two double-stacks were stripped: A double-stack with an Ic of 120A was divided into two single-tape with Ic of 31A and 68A. The other stack with an Ic of 140A was divided into two single-tape with Ic of 51A and 72A.
- Apparently, because of the manual stripping the YBCO face damaged tapes had a secondary Ic attenuation. The adhesion of the copper-plated layers caused by the stacked structure does not intrinsically reduce the critical current.



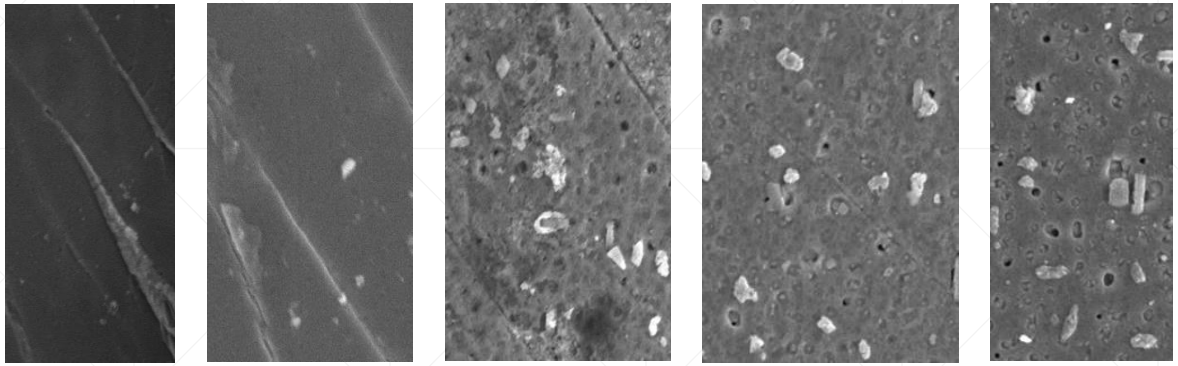




Mechanical damage

- In the co-extrusion process, YBCO tapes will withstand a compressive stress of **50~100 MPa.** Could this stress cause mechanical damage?

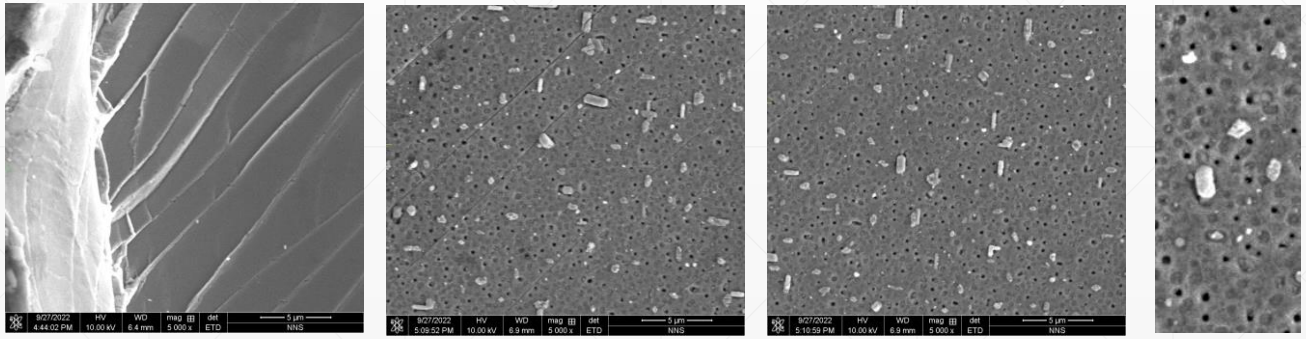
- Original tape before co-extrusion



Border Move inward **0.03mm** **0.05mm** **0.1mm** **0.12mm**

Micro cracks with distribution width of 0.1mm are caused by mechanical slitting.
(Occurs only on one side of the slit.)

- Original tape before co-extrusion



Border **Move inward 0.1mm** **0.2mm** **0.3mm**

The crack expands to 0.2-0.3mm.
It also occurs in one side (slitting side).

Preliminary conclusion: The mechanical damage caused by the pressure in the co-extrusion process is very small, about 5%