

Repair method of locally defective or damaged coated conductor using the superconducting patch

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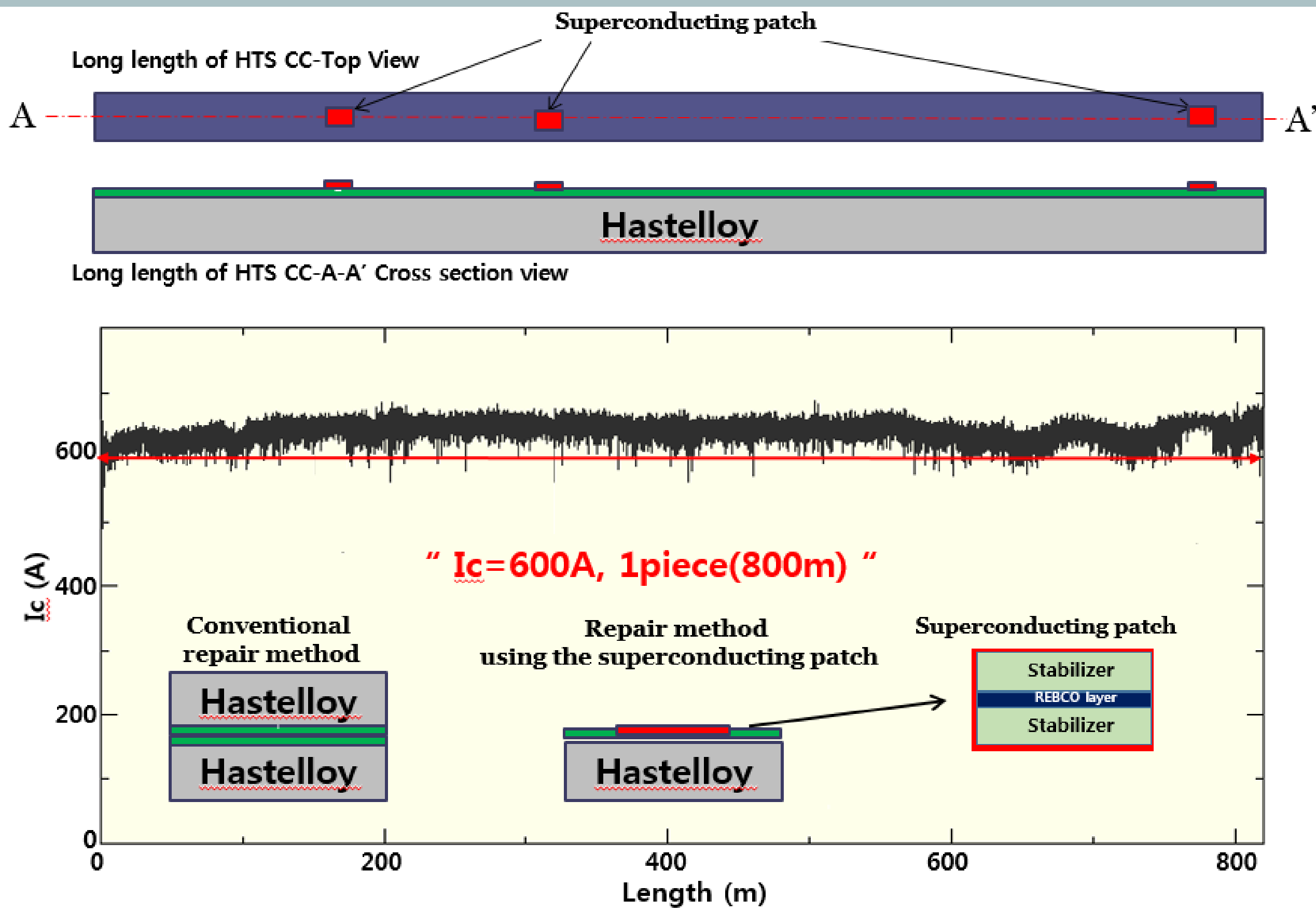
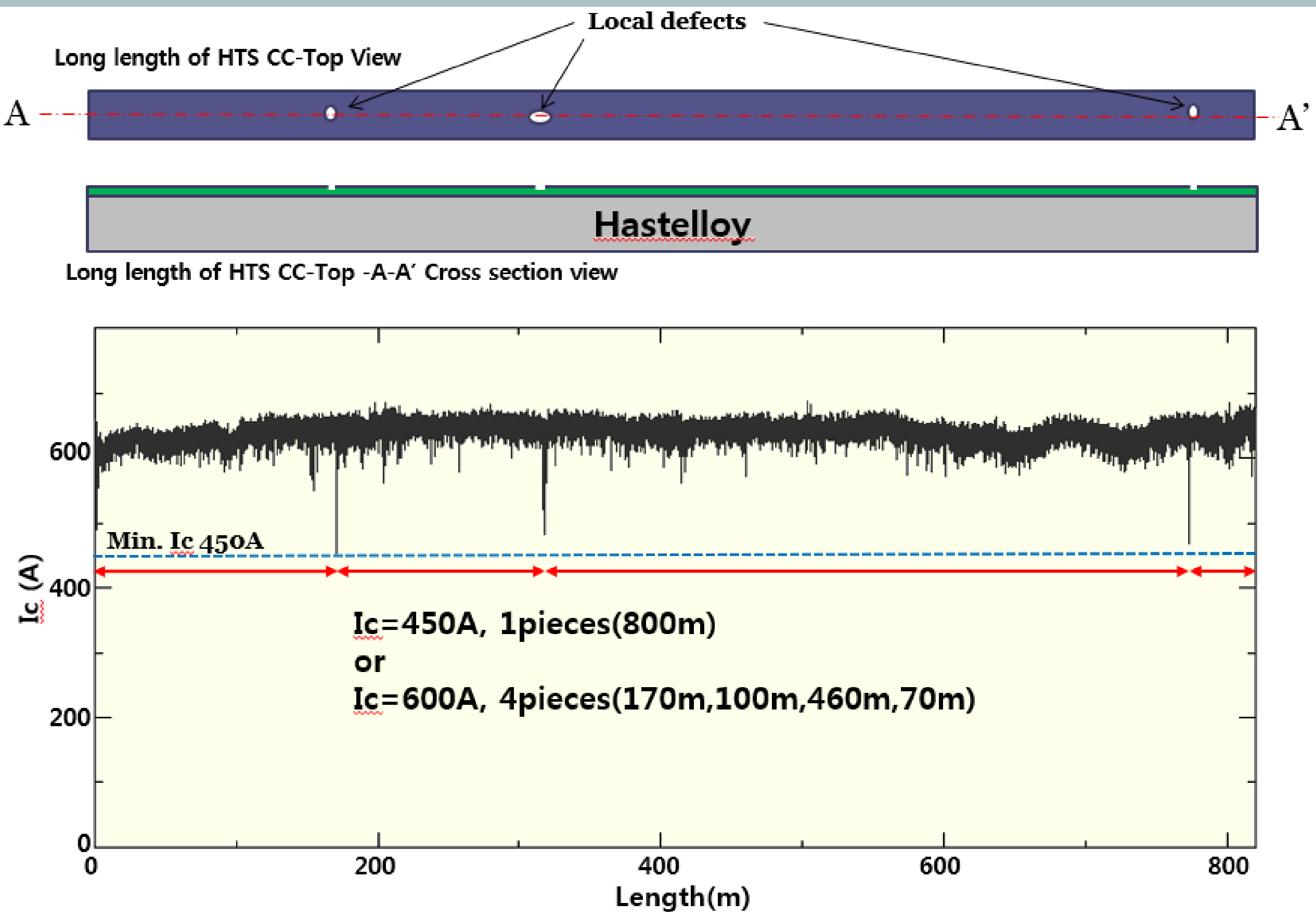
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Abstract

We have proposed a method for effectively repairing locally defective or damaged REBCO coated conductors produced during manufacturing REBCO coated conductor or coil winding for magnet applications using superconducting patch. The superconducting patch was fabricated by separating the metal substrate from the commercial REBCO coated conductor using the interface delamination phenomenon. And it has high J_e (engineering critical current density) coated conductor with simple structure of “Stabilizer / REBCO layer / Stabilizer”. This idea is that a reduced critical current can be recovered by attaching a superconducting patch to the defective or damaged coated conductor. In this experiment, recovery rate of I_c was achieved 72% using superconducting patch for local defects generated during the coil winding.

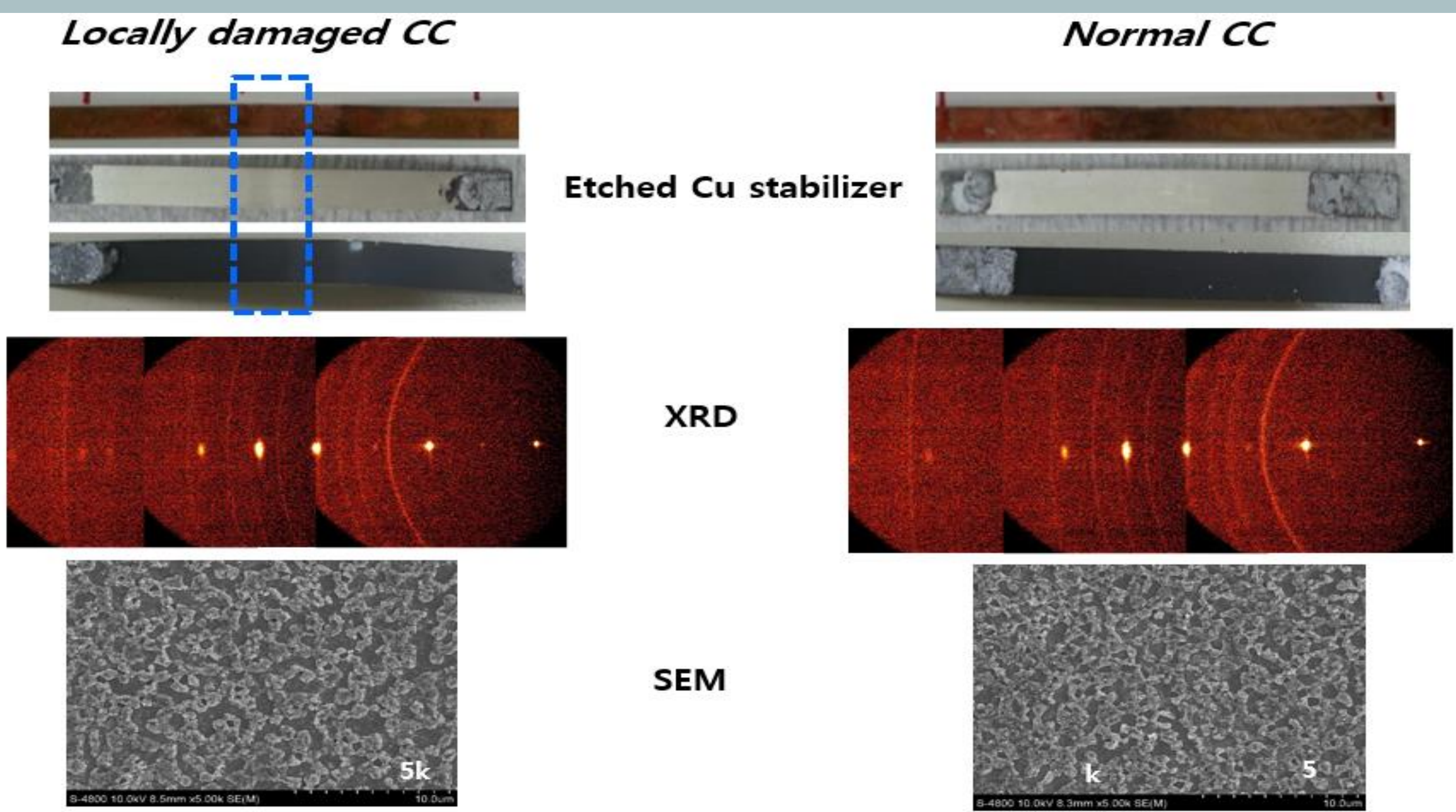
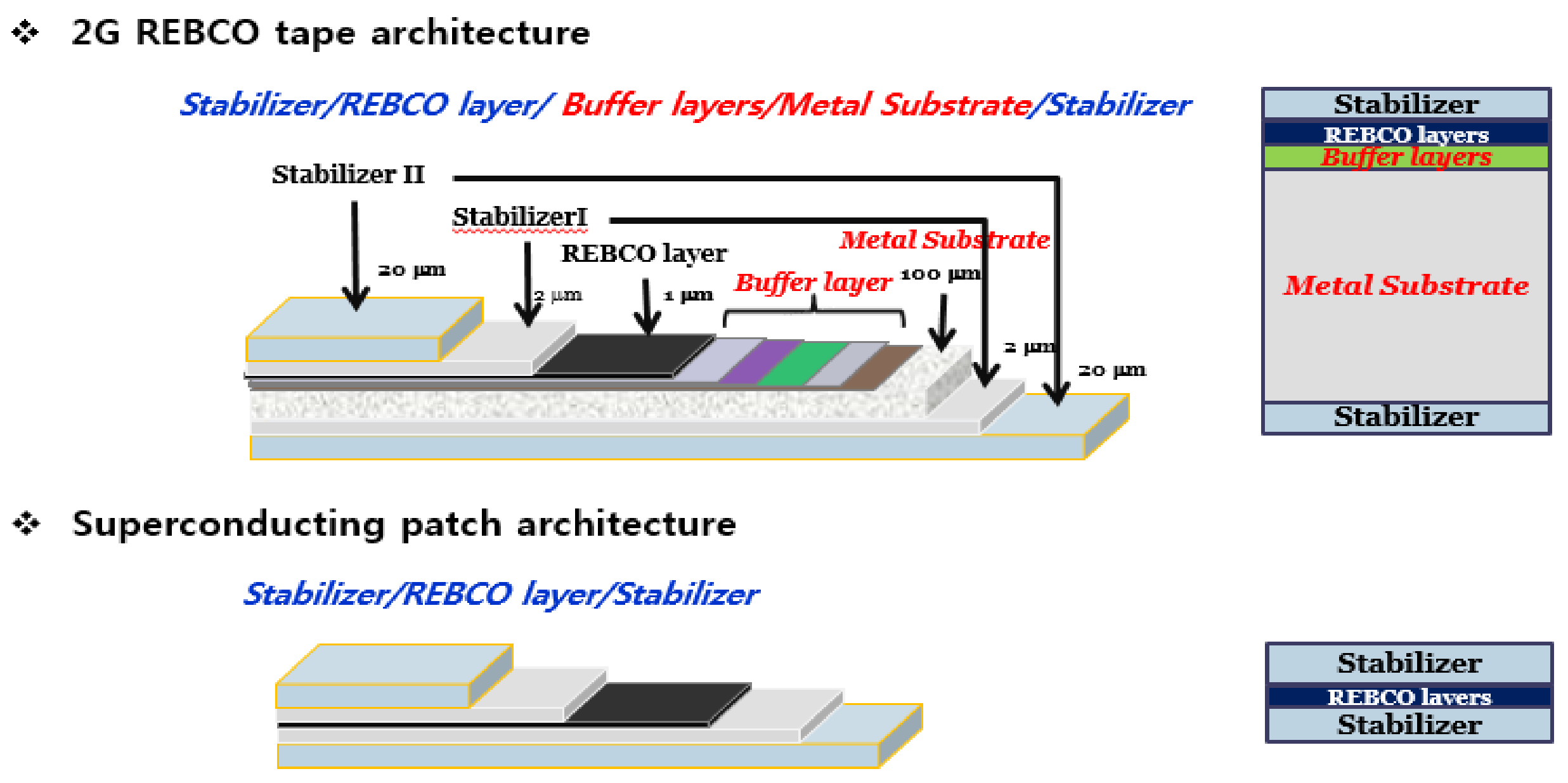
Introduction

- ❖ Needs for joints of REBCO coated conductor
 - Connection between winding coils
 - Length extension of REBCO coated conductors for coil winding
 - Local defects repair by mistake during REBCO coated conductors handing work
- ❖ Joint methods
 - Low-resistive joint (Lap joint)
 - Lamination of two REBCO coated conductors using solder
 - Important to lower joint resistance
 - At least twice the thickness of the joint
 - Zero resistive joint (superconducting joint)
 - Not yet common technology
- ❖ Recovery REBCO coated conductor for locally defects
 - Recovery by low-resistance joint to localized defects using the superconducting patch with metal substrate removed from conventional REBCO coated conductors
 - Patent : 10-2015-0132573, PCT/KR 2016/009907 (Korea)

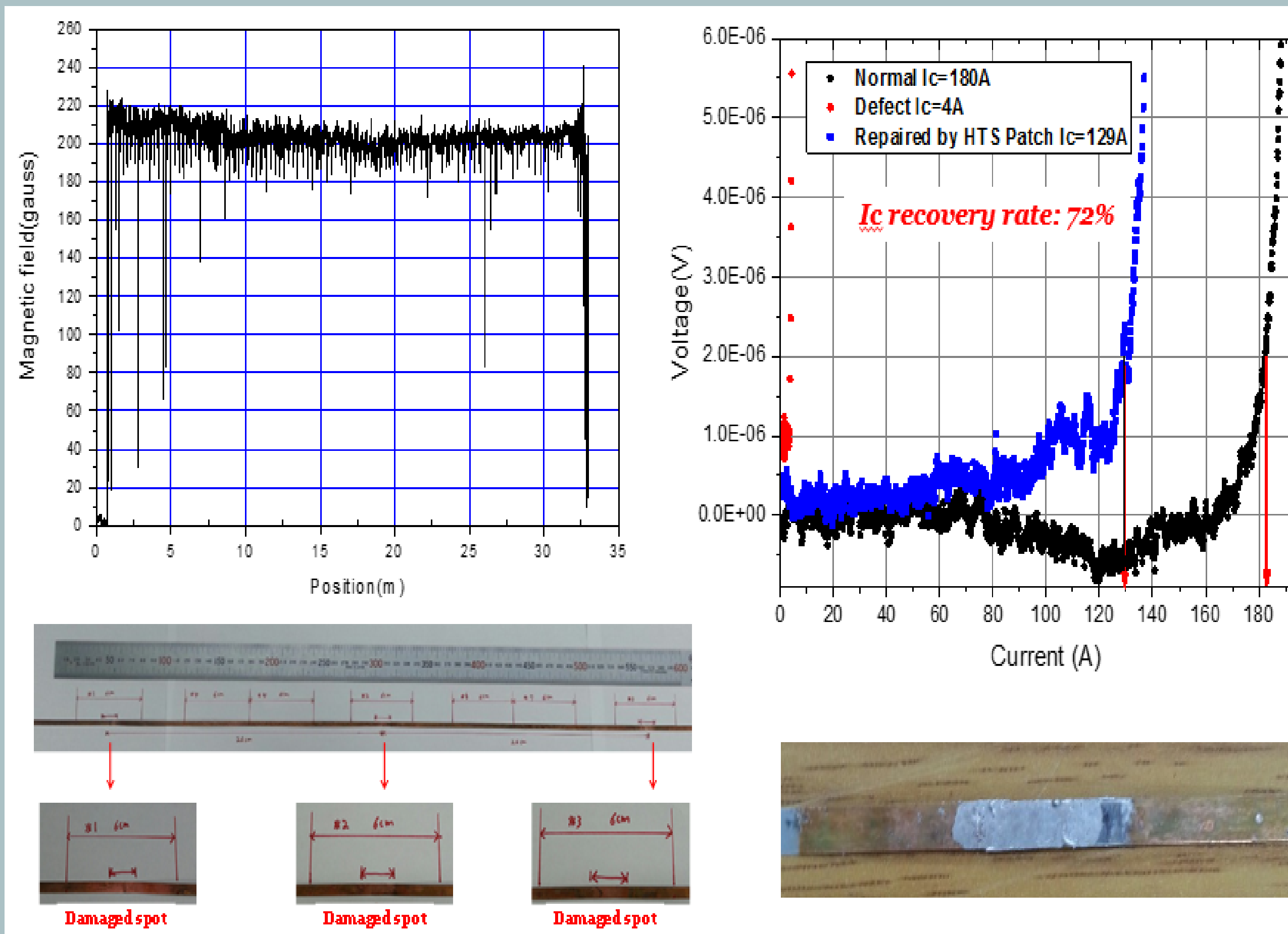


Experiment and Results

- ❖ Manufacture of Superconducting patch
 - Remove metal substrate(70~100um thickness) and buffer layers from commercial REBCO coated conductors
 - Superconducting patch(< 50um thickness) with architecture of “Stabilizer/REBCO layer/Stabilizer” for repairing defective and damaged REBCO coated conductors
 - Patent : 10-1410841(Korea), 14/713233(USA), 2015-546728(Japan)



- ❖ Sample Coated Conductor
 - Periodic damaged REBCO coated conductors due to foreign material during the coil winding
 - $I_c=182A/4mm_width$ at 77K-Self field, Cu plating Stabilizer
 - No Insulation winding for test coil



Conclusion

- ❖ Confirmed the possibility of local defect repair of REBCO coated conductor using superconducting patch
 - Superconducting patch with architecture of “Stabilizer/REBCO layer/Stabilizer” by removing the metal substrate and buffer layer from conventional REBCO coated conductors
 - Achieved 72% recovery rate of I_c using superconducting patch for local defects generated during the coil winding while minimizing increase in joint thickness
 - Experiment underway to improve the recovery rate of I_c by minimizing joint resistance with superconducting patch
- ❖ Expected effect of this technology
 - Restoration of the length of long-length REBCO coated conductors with local defects during the production process
 - Superconducting magnet performance recovery through recovery of unexpected local defects during coil winding