

A method of Critical Current measurement for the HTS tape using Pulse current

A.R. Kim¹, Z.S. Lim¹, T. Kim¹, K. Yun², S. Yoon³, M. Park⁴, I.K. Yu⁴

1. Research Institute of Industrial Science and Technology, 2. Kyusu Institute of Technology, 3. SuNAM Co., Ltd, 4. Changwon National University

arkim83@rist.re.kr

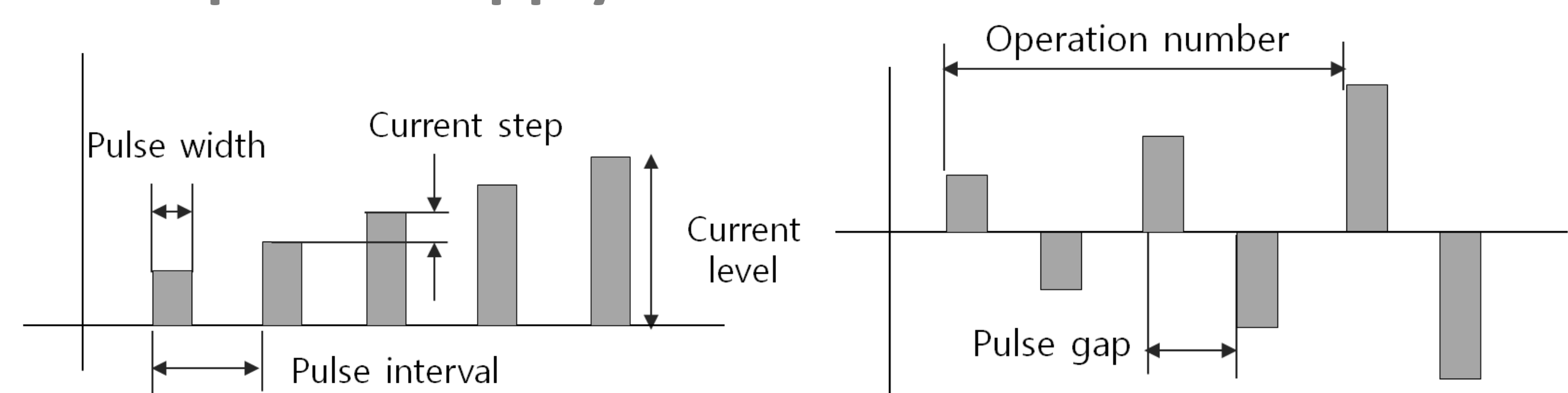


Introduction

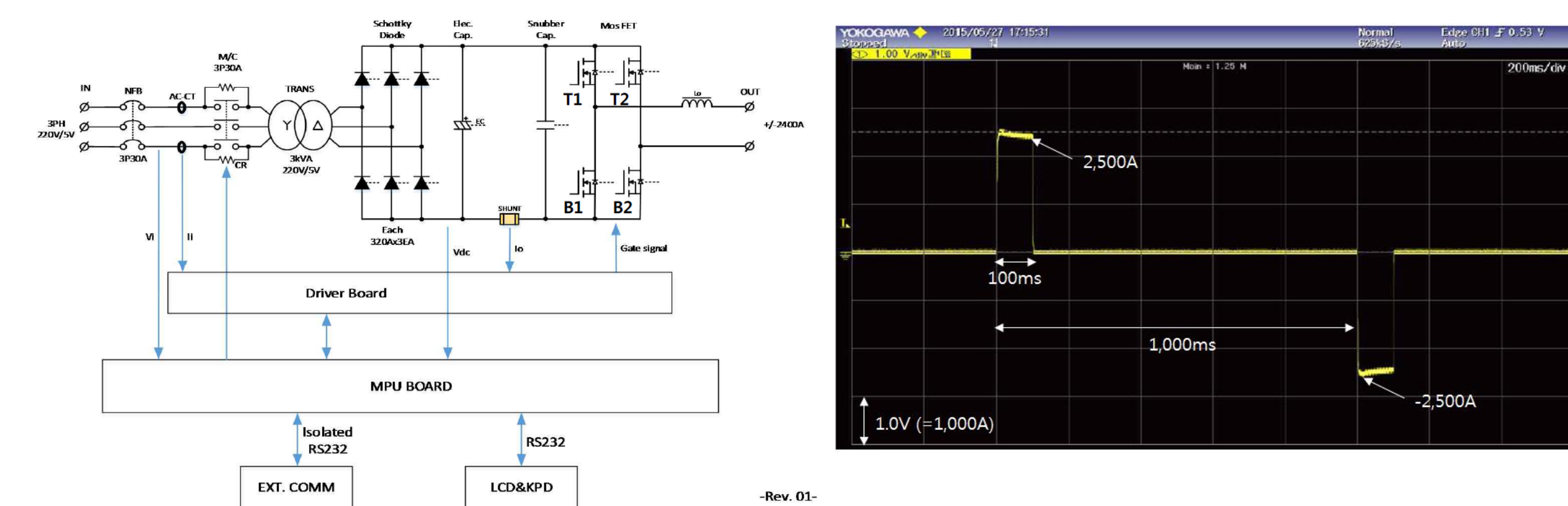
To evaluate the critical current (I_c) of HTS tape in various temperature conditions, the cryostat with conduction cooling system is widely used with DC power supply. But the continuously increasing DC current affects the temperature rising of metallic parts by joule heating. The temperature increasing seriously influences the measuring factors which are voltage, resistance, or temperature, and then users may get the wrong results. To minimize the heating effect, the pulse current was considered instead of DC current for power supply. Both DC and pulsed current were tested to the same HTS tape.

Design & Manufacturing

Pulse power supply

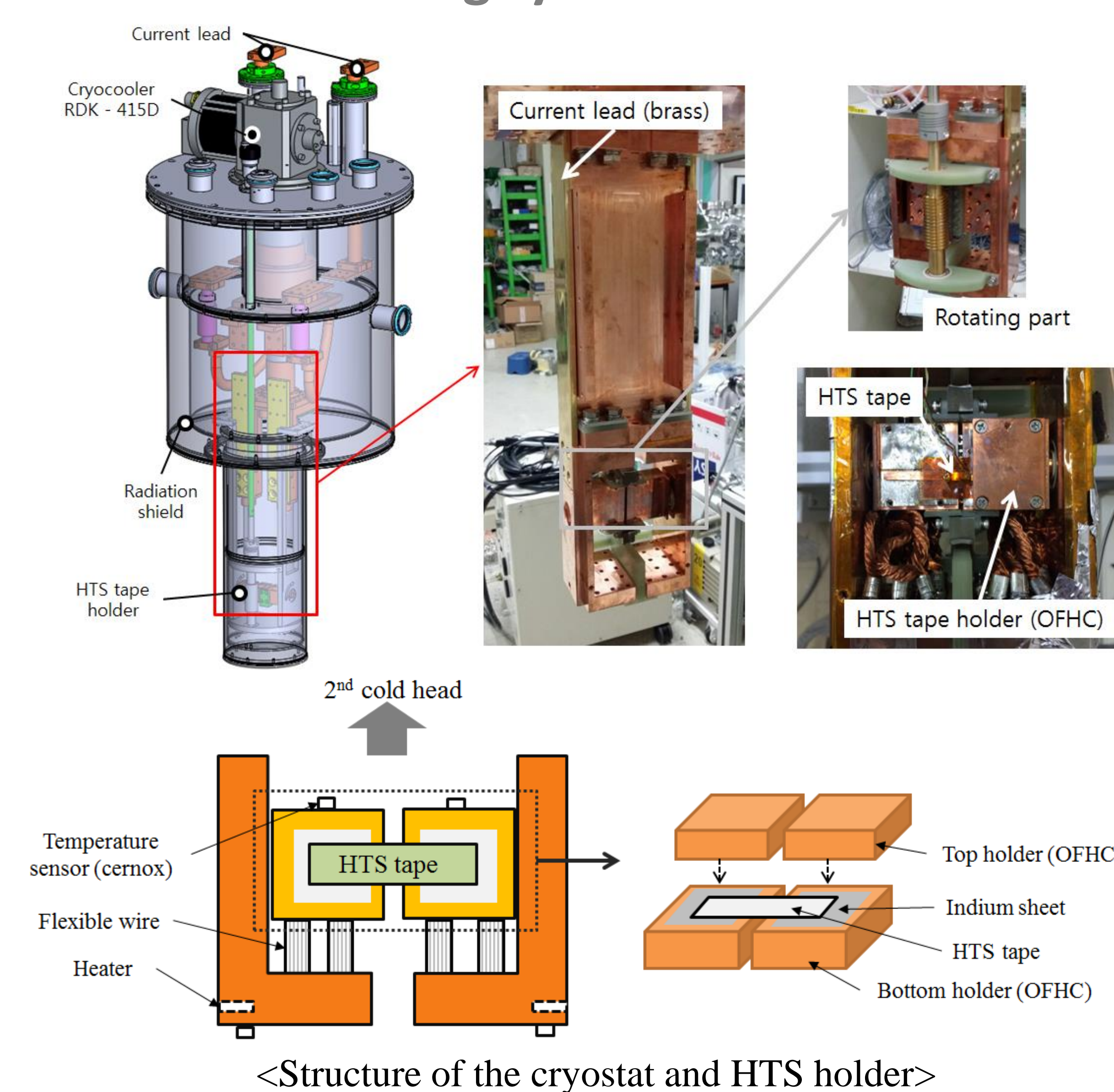


<Types of pulse mode (a) uni-polar pulse mode. (b) bi-polar pulse mode>



<Block diagram of the pulse power supply & output current of the pulse power supply; 2,500A, 100ms pulse width, 10% duty in Oscilloscope>

Conduction cooling system

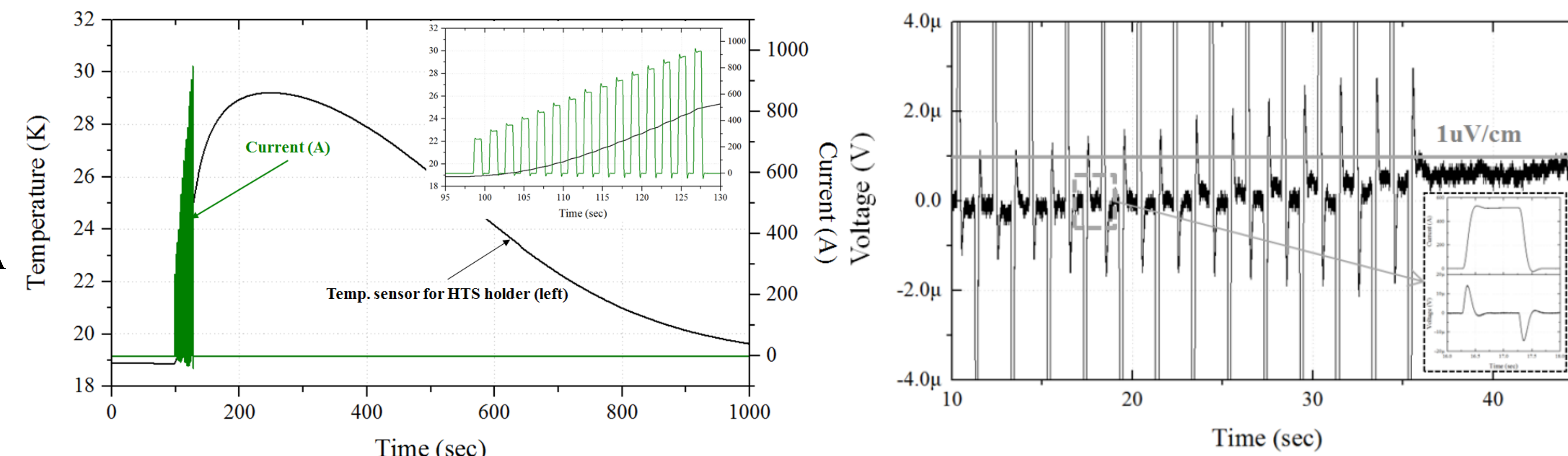


<Structure of the cryostat and HTS holder>

I_c measurement results using pulse current

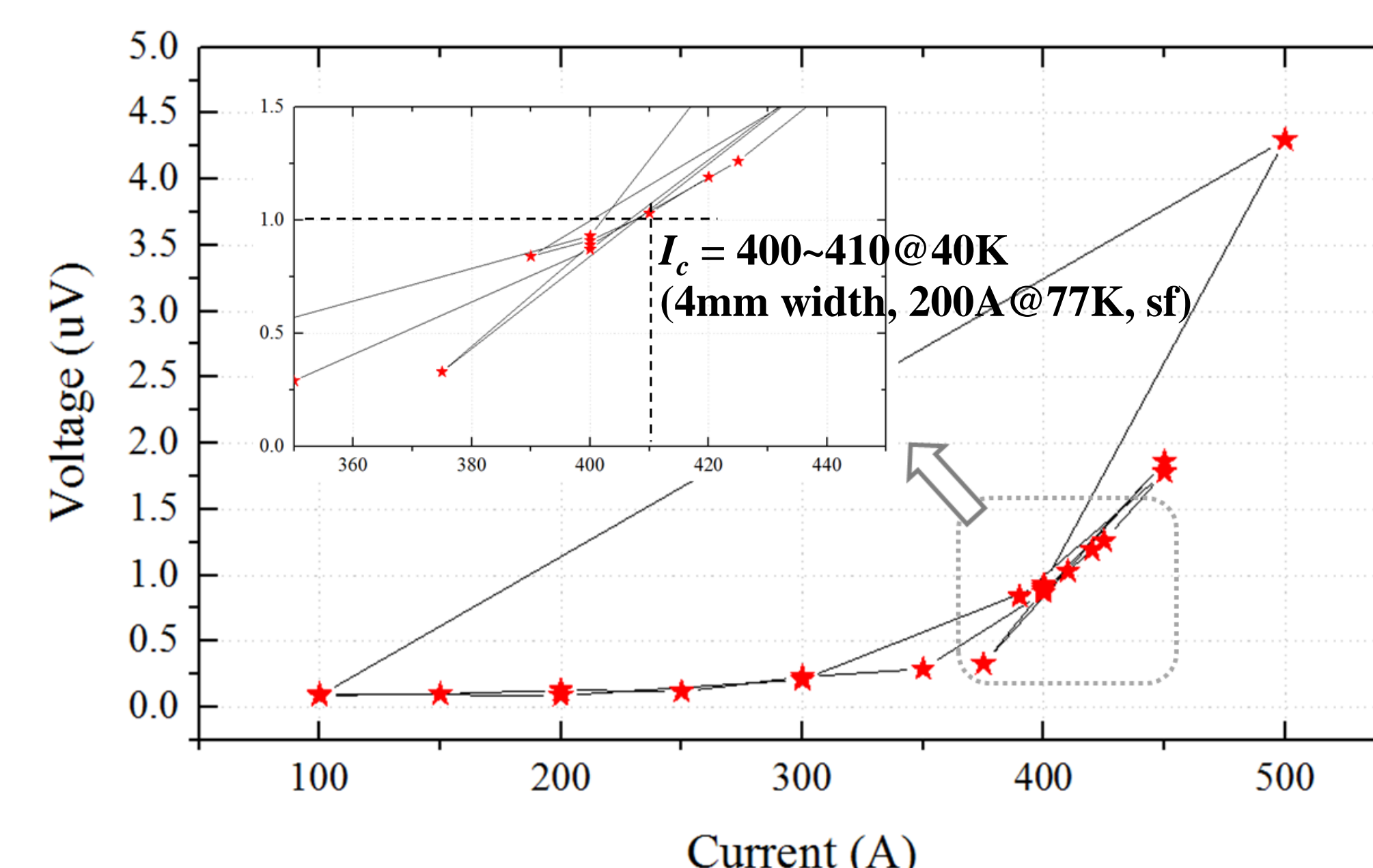
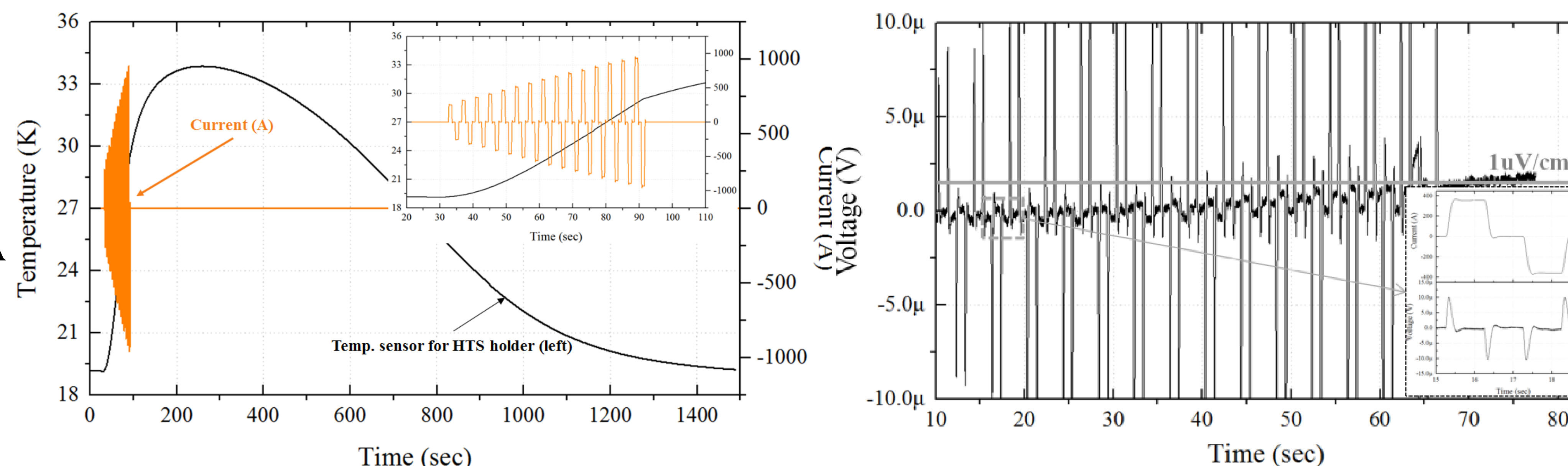
Uni-polar mode

- Current step : 50A
- Pulse width : 1sec
- Initial current : 300A
- Pulse interval : 2sec

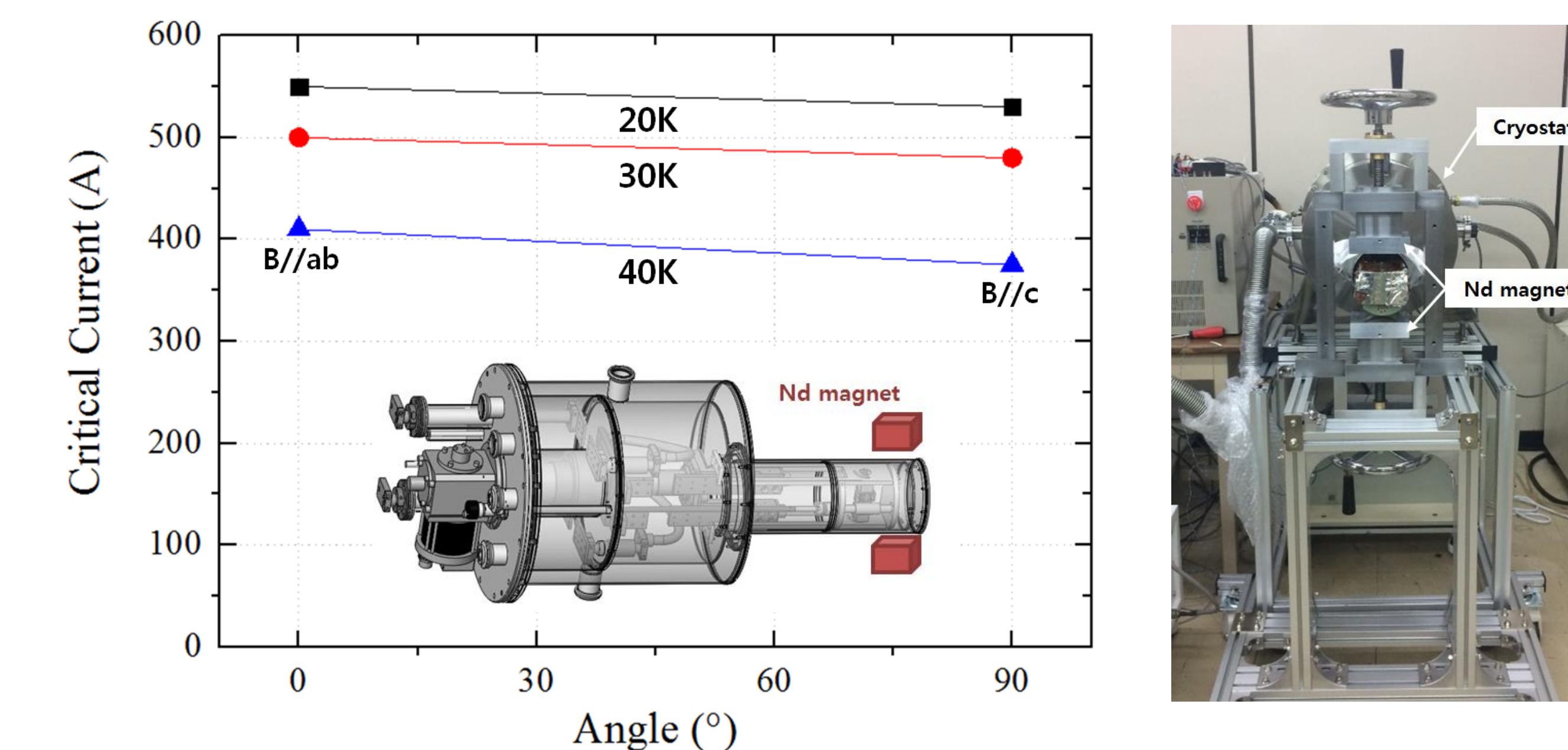


Bi-polar mode

- Current step : 50A
- Pulse width : 1sec
- Initial current : 300A
- Pulse interval : 4sec
- Pulse gap : 2sec

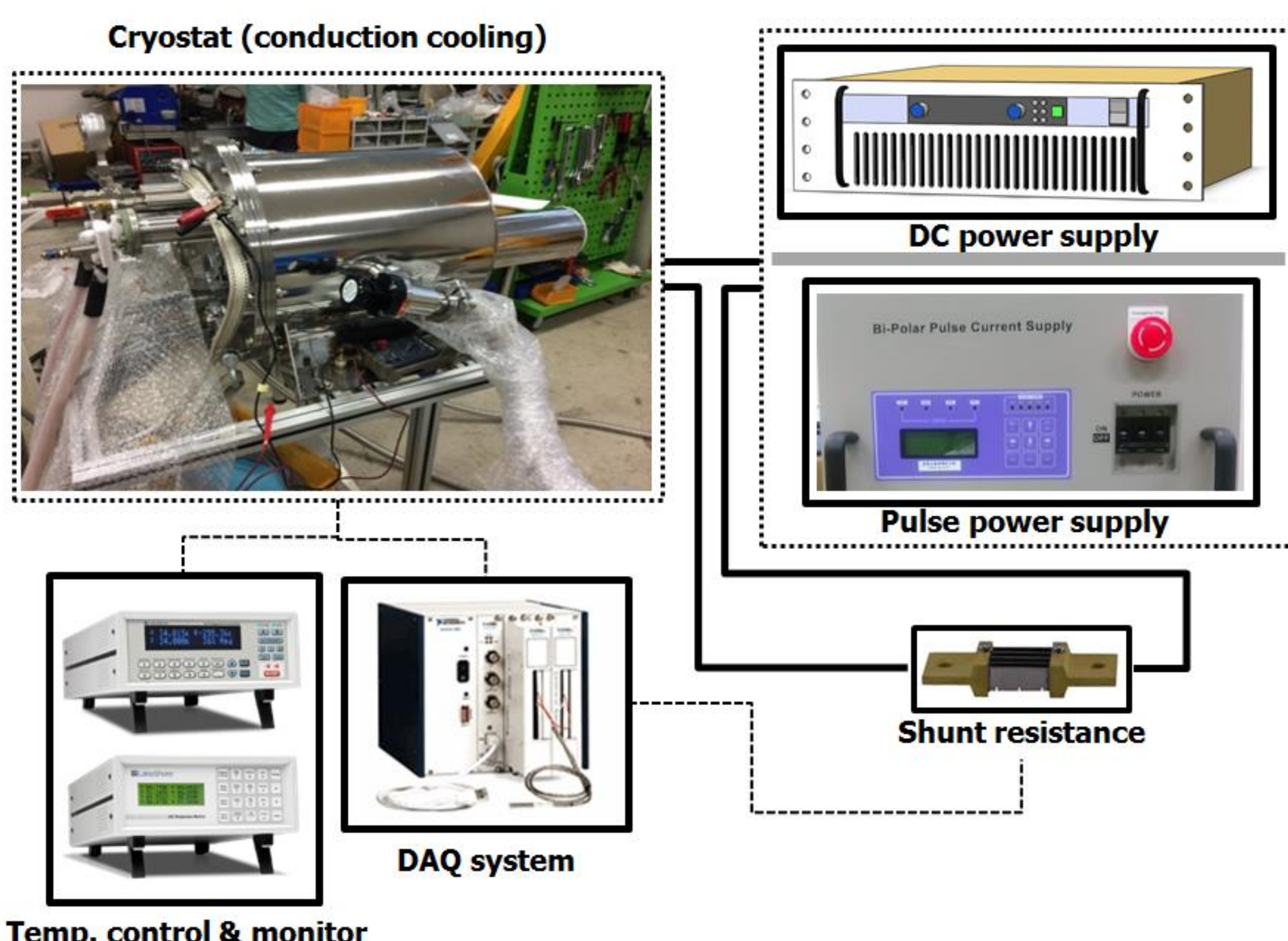


< I_c measurement results using bi-polar pulse current>

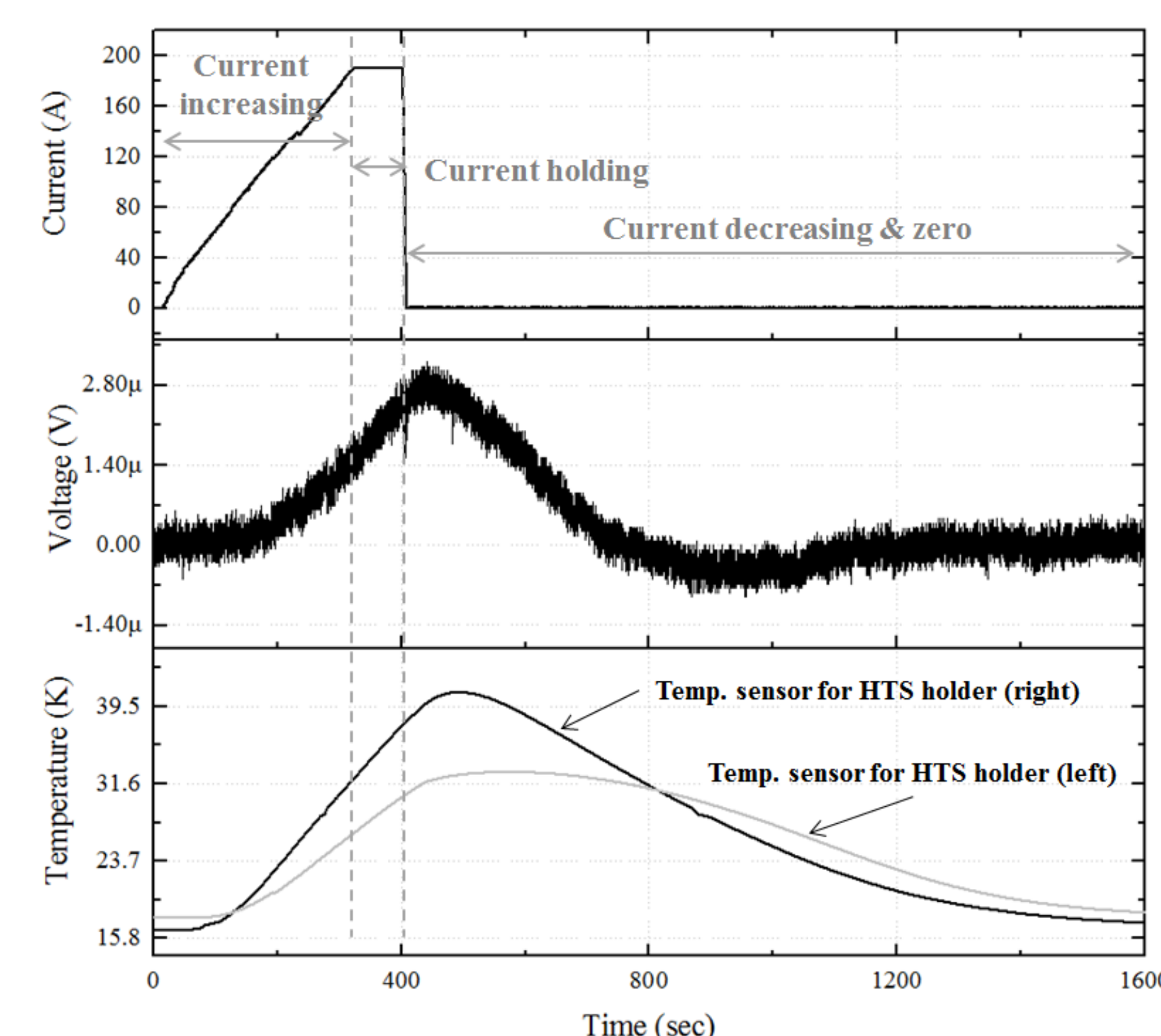


< I_c measurement results (T, θ , B) / max. B = 0.1T>

I_c measurement using continuously increasing current



< I_c measurement system>



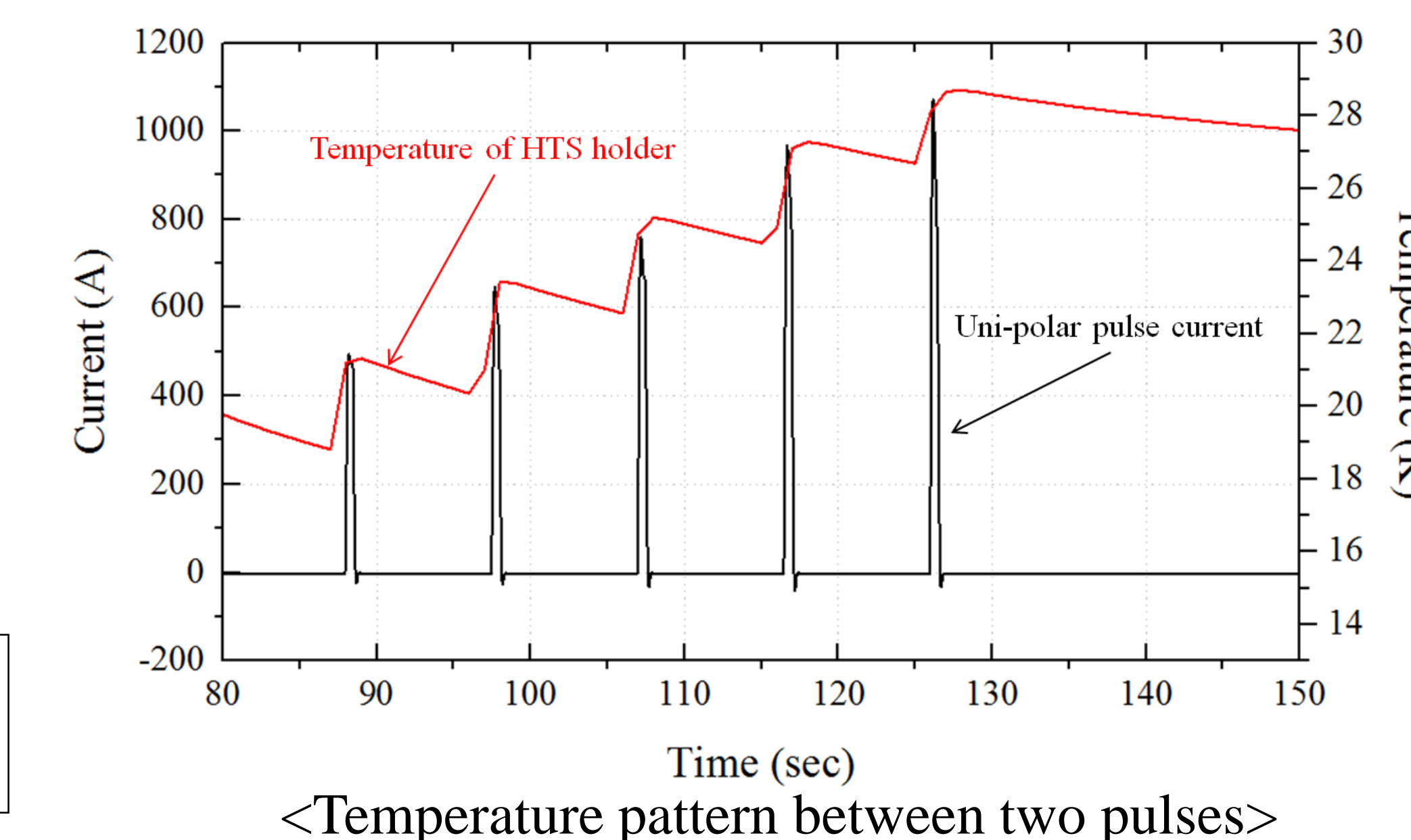
<Temperature-voltage-current waveform by DC current increasing>

- Non-uniform temperature profile occurs thermoelectric power (TEP) effect

Conclusions

- To minimize the temperature rising during the measurement in the same cooling capacity, the enough time for cooling is needed.
- It is very important to find out the optimal conditions such as pulse interval, gap and width to reduce of the temperature rising effect.
- The precise conditions for I_c determination and n-value assessments is still under study

This work was supported by the Korea Institute of Energy Technology Evaluation and Planning(KETEP) and the Ministry of Trade, Industry & Energy(MOTIE) of the Republic of Korea (No. 20131010501800).



<Temperature pattern between two pulses>