[1128] Study on the Transport Current Properties for the 2G HTS Wire Under the Spray Cooling Method

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1. Abstract

This study is about the cooling of the superconducting wire by spraying the liquid nitrogen. In this study, the superconducting wire was cooled under the spray cooling condition, and a current flow test was conducted. In addition, the operating range of the superconducting wire was presented under the spray cooling condition of the liquid nitrogen. For this, a low temperature container with a spraying device was fabricated, and the cooling performance of the container was evaluated.

The YBCO superconducting wire for the spray cooling test had the stainless steel wire as stabilizer layers. The wires were the representative superconducting wires that were fabricated using the sputtering techniques. The current flow test was conducted in the normal and over current conditions, and the results were compared with those of the existing immersion cooling method.

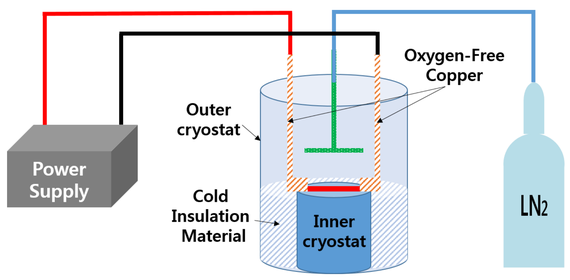
2. Properties of YBCO thin-film wire

• Physical properties of AMSC 344S YBCO thin-film superconducting wire.

YBCO CC St / AMSC 344S	
Stabilizer	Stainless steel
Layer of /pattern/width/thickness	20㎝/4.4㎜/0.2㎜
Ic & Tc	70A_{rms} (1㎶/㎝, @77K), 90K
Voltage rating & Resistance	0.6 V_{rms}/cm, 3.7mΩ/㎝ (@300K)
Resistance at temperature	80 mΩ

3. Experimental Set up

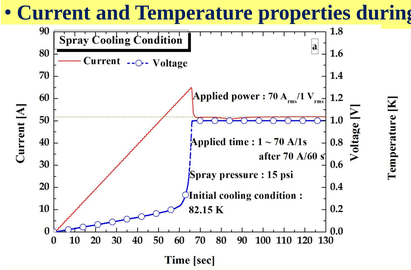
• Testing system

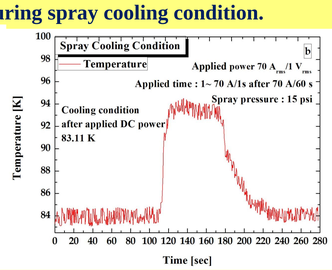


The schematic diagram of the experiment equipment

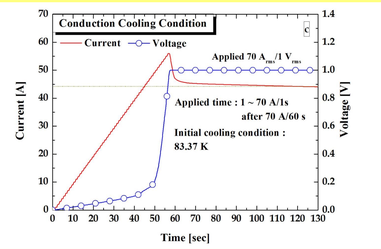
4. Analysis of the current characteristics according to the refrigerant cooling method

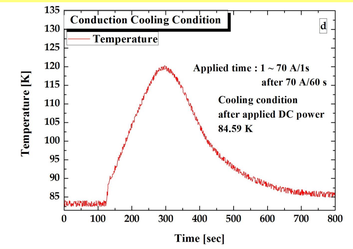
• Current and Temperature properties during spray cooling condition.



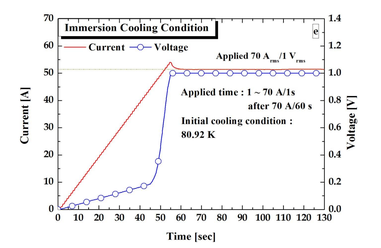


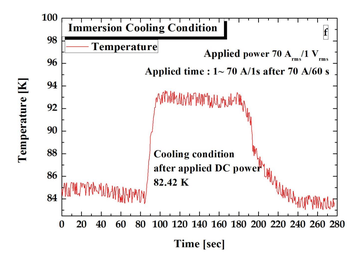
• Current and Temperature properties during conduction cooling condition.





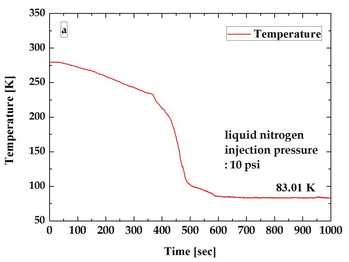
• Current and Temperature properties during immersion cooling condition.

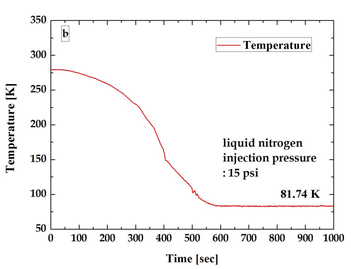




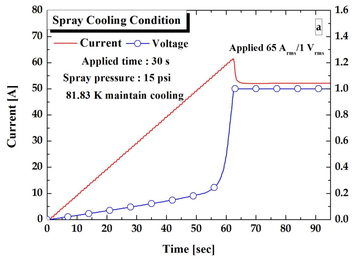
5. Analysis of the cooling performance according to the refrigerant spray pressure

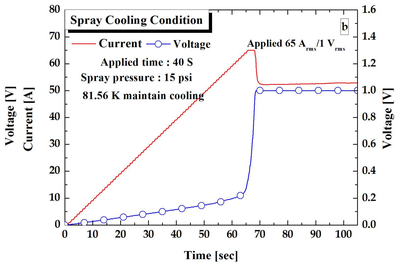
• The analysis of the cooling performance according to the refrigerant spray pressure.

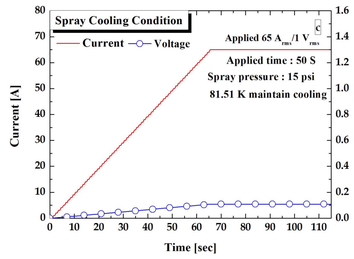


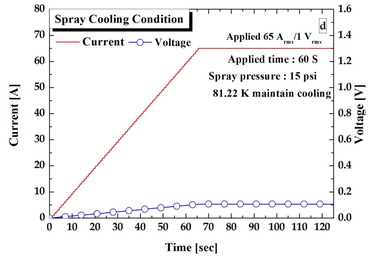


• The analysis results of the current characteristics according to the refrigerant cooling time.









6. Conclusions

● Superconducting cables, which can consider environmental issues as well as efficient operation of energy, are on the verge of commercialization. One way to accelerate the commercialization of superconducting cables is to create more demands. Considering this, the most appropriate demands will be created by DC power sources such as photovoltaic power generation. Therefore, this study aimed to secure the new-type element technology of superconducting cables. For this purpose, a spray cooling system that is expected to cool superconducting wires faster than the conventional impregnation cooling system was proposed, and the cooling performance test as well as the DC current test were performed. The test results showed that the spray cooling system exhibited the same tendency as the conventional impregnation cooling system and that the increased spray pressure and spray time resulted in more excellent cooling performance. If a cooling performance analysis is conducted for increased spray pressure and the spray pressure maintenance conditions according to the spray distance are established, the proposed key technology of superconducting cables will be secured.

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