Contribution ID: **392** Type: **Poster**

Wed-Af-Po.04-02: Predictability of the change in solder resistance under thermal cycling conditions

Wednesday 2 July 2025 14:30 (2 hours)

The solder layer in electronic systems has been the subject of a vast number of studies in the field of reliability assessment due to the weakness of this layer and the large difference between its mechanical characteristics and those of the rest of the system. Among these characteristics, the difference in the coefficient of thermal expansion drives the generation of thermal stress, which can result in performance degradation and the possibility of failure during long-term operation. This issue becomes more significant in the case of a superconducting system, because the system is exposed to a wide range of temperatures. The results relating to the reliability of the solder layer revealed an interesting phenomenon. The resistance of the solder layer started to rise after a certain number of cycles of thermal stress application, whereas it remained almost consistent before the threshold. Based on our previous study on the long-term operation of a current lead, which showed a similar change in the terminal resistance, we planned and conducted a study to test the consistency of the threshold point for the rise in resistance, to use it as a means to predict the long-term performance of a system containing a layer of solder. Toward this purpose, we prepared multiple samples consisting of superconducting tape and copper blocks that are connected to each other with a layer of solder. To compare their change in resistance quantitatively, the soldering conditions were controlled by an electronic system, and the samples were exposed to the same thermal cycles. Finally, the samples were compared in terms of the change in their terminal resistance to evaluate whether the controlled conditions result in a similar threshold of resistance.

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Session Classification: Wed-Af-Po.04 - HTS Joints