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HTS Magnet with Smart Insulation Method

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If a quench occurs in an HTS magnet, it is almost impossible to protect the magnet from being burned. So far, it was usual to wind a magnet with insulated wires. However the insulated magnets are easily burned by a quench. To solve this problem no-insulation winding technique is developed recently. A no-insulation magnet shows very stable performance. However this magnet shows very poor controllability; when we charge the magnet, for example, it is not possible to build the magnetic field on time, because of large delay. Some people are trying to use metal co-winding method. The co-winding technique is a trade-off, and it is not easy to satisfy the stability and controllability. This paper suggests an advanced way to satisfy the stability and controllability together. This new way adopts metal–insulator transition (MIT) material between turns of HTS magnets. MIT material is an insulator when the temperature is lower than a certain value. Above the certain temperature, the MIT material becomes a conductor. This transition can be used as a switch between turns of HTS magnets. We call this smart switch operating by the temperature as "Smart Insulation."Considering the operating temperature, we selected V2O3 as the material for the smart insulation. In this paper, a fundamental experiment with regard to the MIT characteristics was conducted to prove the feasibility of the proposed method, and the resistivity change was verified according to the temperature of the V2O3 material manufactured in a form that can be easily applied to the magnet. In conclusion, we have experimentally verified that the advantages of both the insulation magnet in a normal state and the no-insulation magnet during quenching could be simultaneously obtained.

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