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Unbalanced Torque in High Magnetic Field No-Insulation REBCO Pancake Magnet after Quench

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A REBCO pancake coils using a no-insulation (NI) winding technique is received attention. An NI winding technique greatly enhances the thermal stability of REBCO pancake coils, and it is desired to be applied to high magnetic field NMR/MRI magnet, etc. The high thermal stability of NI REBCO magnets was confirmed in many experiments and numerical simulations, even though any accident due to mechanical or thermal factors caused a quench of NI REBCO magnets. However, a new problem arised after a quench when an NI REBCO magnet was operated under a high magnetic field. When NI REBCO pancake coils transitions into a resistive state, the operating current bypasses a turn to adjacent turns in the coil-radial direction. That is an inherent feature of NI REBCO pancake coils. The radially bypassing current flows under a high magnetic field, so that the Lorenz force is generated in the coil-circumferential direction. This circumferential force works to the quenched NI REBCO pancake coils as a torque. The coils or joints may be damaged by unbalanced torque. When NI REBCO pancake coils transition into a normal state, most of the operating currents carry in the radial direction. In cases of a large operating current, the large torque has to be considered to protect from damages. Moreover, the larger bore and/or the larger thickness NI REBCO magnets have, such as a high-field whole-body MRI application, the larger torque is generated. So far, an overcurrent test or a quench test of NI REBCO pancake coils under a magnetic field higher than 10 T has not been reported. Hence, there is no report about unbalanced torque generated in NI REBCO pancake coils. In this paper, we will discuss a risk of unbalanced torque generated in high magnetic field NI REBCO pancake coils after quench.

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