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Mechanical problems for a Ni-alloy reinforced Bi-2223/Ag conductor -Towards a super-high field compact magnet-

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Recently, tensile stress tolerance of a Bi-2223 conductor has been drastically improved. Conventional Bi-2223 conductors with copper-alloy reinforcements or stainless steel reinforcements show tensile stress tolerance of ˜250 MPa. The stress tolerance has been improved to 400-500 MPa with Ni-alloy reinforcements in combination with a pre-compression of Bi-2223 filaments/Ag-matrix [1]. This type of high mechanical strength Bi-2223 conductors are promising for developments of super high field magnets as they tolerate high hoop stress, resulting from high current density and a high magnetic field beyond 23.5 T.
However, it is probable that this type of composite conductor is easily damaged by a release of strain energy inside the conductor; note that the Bi-2223/Ag conductor has a compressive strain, while the reinforcement tensile strain. In fact, a notable fracture of a conductor after a thermal runaway was observed [2]. From the standpoint of coil protection, mechanism and a method to prevent this phenomenon are important. In this work, these are systematically investigated with a model experiment.
A piece of a high-mechanical strength Bi-2223 conductor was heated on a hot plate. Temperature and strain along the conductor longitudinal direction on a surface of the conductor were measured with a thermocouple and a strain gauge, respectively. The strain gauge showed a drastic change in strain at a temperature of ˜200 ℃. After the experiment, the Bi-2223/Ag conductor shows a curve among the delaminated Ni-alloy reinforcements; i.e. the Bi-2223/Ag conductor was buckled. The result shows that strain energy was released by a melting of a solder which bonds the conductor and the reinforcements, resulting in a collapse of the composite conductor. The method to prevent the phenomenon will be investigated.

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