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Experimental study on the effect of twisting on critical currents of Nb3Sn cable-in-conduit conductors

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Cable-in-conduit (CIC) conductors made of Nb3Sn wires have been developed for use in large high-field magnets. A “wind, react and transfer” method has been established to avoid the degradation by excess strain after reaction of Nb3Sn and to adopt organic insulator. However, the “react and wind” method is preferred for a helical coil for a helical fusion reactor, because the “transfer” process is difficult to be adopted after being wound into the three-dimensional configuration. In this concept, a CIC conductor is heated for reaction of Nb3Sn on a bobbin with the same equivalent radius of the helical coil, and transferred to a reel that revolves through the helical coil. Nextly, the conductor is pulled aside, that is, twisted, and wound in a coil case. According to the experimental study with a model CIC conductor, the tensile strain is induced in the wires by twisting the conduit in the same direction as the wire twisting direction, as expected. In this experiment, the amounts of change of longitudinal normal strain in the wires are in the order of 1/10 of the highest normal strain in the conduit. The change of strain in the wires is considered to be lessened by slippage of the wires to the conduit. Since the compressive strain in the wires can be slightly lessened by twisting the conductor, the react-and-wind method is expected to be applicable for the helical coil without degradation or with slight improvement of the conductor performance. In order to confirm this effect, small CIC conductor samples in spring-shape are prepared. The torsion strain is induced on the conduits by changing the length of the spring, and the change of the critical current is measured in liquid helium with a background field. The first experimental results are presented.

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