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A Novel High Heat Capacity Resin for Impregnation of Nb3Sn Superconducting Magnets

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A major focus of Nb3Sn high field accelerator magnets for HEP is on significantly reducing or eliminating their training by understanding the underlying physics mechanisms. We have been are investigating whether mixing organic olefin-based thermosetting dicyclopentadiene (DCP) resin, commercially available as TELENE○R by RIMTEC Corporation in Japan, with high heat capacity ceramic powders, increases heat capacity Cp of impregnated Nb3Sn. Using a high Cp DCP resin as impregnation material for Nb3Sn magnets is expected to considerably increase the specific heat of the superconducting coil package when compared with standard impregnation epoxies (CTD-101k). This novel technology will contribute to reduce Nb3Sn superconducting magnet training at a minimum cost.
The high heat capacity resins in this study were fabricated by a combination of a ceramics powder filler and the DCP resin. The DCP resin is typically cured by the use of an additive, which is the ruthenium complex. The curing time is controlled by the amount of retardant. The powder filler is selected among high heat capacity ceramics, such as Gd2O3, Gd2O2S, and other magnetic regenerating compounds. Al2O3 and SiO2 powders are used for standard fillers as a comparison. These powder fillers are mixed with the DCP resin by using a planetary mixer. The viscosity, heat capacity, thermal conductivity and other physical properties of the DCP resins with powder fillers were measured in this study.

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