First Results on High-Specific Heat Organic Resins for Superconducting Magnet Impregnation

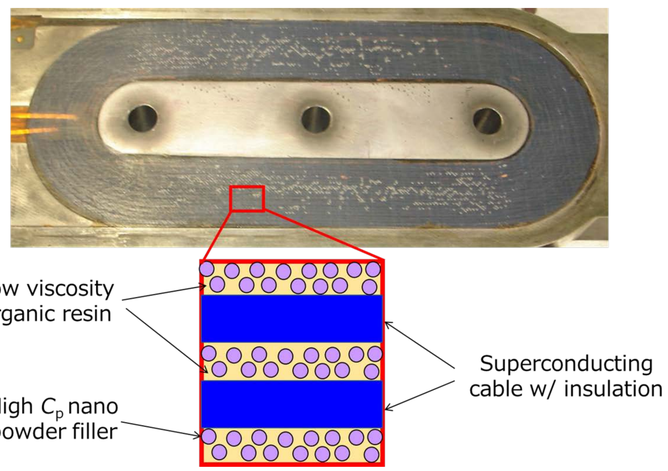
Emanuela Z. Barzi[1)], Akihiro Kikuchi[2)], Masaki Takeuchi[3)], Kazuto Hirata[2)], Daniele Turrioni[1)], Nikolai Mokhov[1)], Alexander V. Zlobin[1)], and Kiyosumi Tsuchiya[4)]

1) Fermi National Accelerator Laboratory, USA
2) National Institute for Materials Science, Japan
3) RIMTEC Corporation, Japan
4) High Energy Accelerator Research Organization, Japan

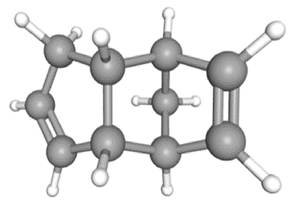
Background and Aim

A major focus of Nb_3Sn 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® by RIMTEC Corporation in Japan, with high heat capacity ceramic powders, increases heat capacity Cp of impregnated Nb_3Sn. Using a high C_p DCP resin as impregnation material for Nb_3Sn magnets is expected to considerably increase the specific heat of the superconducting coil package when compared with standard impregnation epoxies (CTD-101k). We demonstrate this novel technology can contribute to reduce Nb_3Sn superconducting magnet training at a minimum cost.

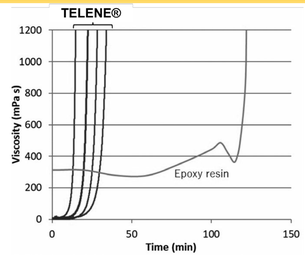
Conceptual Image of SC Magnet



TELENE® by RIMTEC Corporation

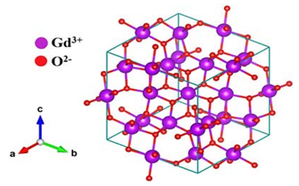


3D conformation of TELENE®, dicyclopentadiene ($C_{10}H_{12}$).

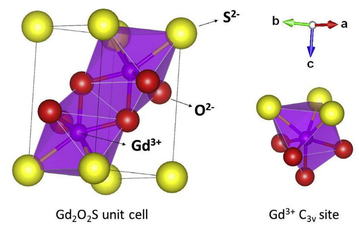


Very low viscosity compered to Epoxy resin.

High-Specific Heat (C_p) Powders in this Study

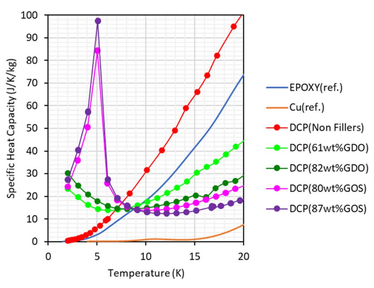


Gadolinium Oxide (Gd_2O_3)

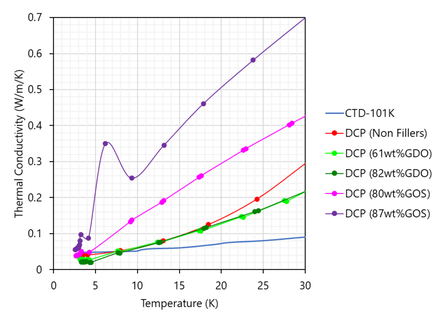


Gadolinium Oxysulfide (Gd_2O_2S)

Specific Heat and Thermal Conductivity

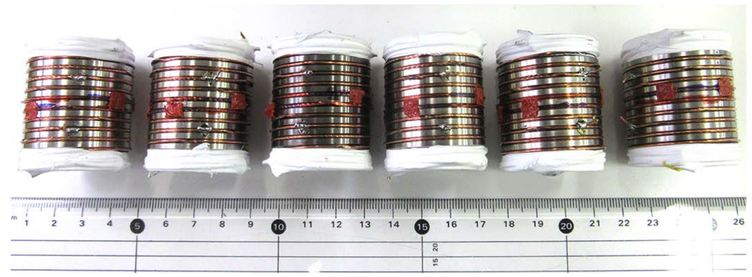


Specific heat of TELENE® w/ or w/o high C_p fillers



Thermal conductivity of TELENE® w/ or w/o high C_p fillers

NbTi Short Samples for MQE Tests



NbTi short samples on Ti-6Al-4V alloy barrel.

Mixing of main agent, fillers, and hardener.

Duration dependent MQEs at 4.2 K and 9 T