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Sudden discharge measurement system and results for 100 mH class no-insulation coils

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We have previously demonstrated proof-of-concept no-insulation style coils wound with a heavily filled conductive epoxy resin system. This epoxy resin system appears to eliminate REBCO delamination, and also allows for tuneable contact resistance between turns. The coils we have reported to date are small coils with an ID of approximately 25 mm and an OD of approximately 50 mm with an inductance of 0.1 mH.
As part of an ongoing National Institutes of Health funded program, we are developing a compact brain imaging MRI magnet using REBCO conductor. We intend to use the conductive epoxy resin system previously reported to provide quench tolerance in this REBCO magnet. The coils for this magnet range greatly in size, however; on average coils are approximately 400 mm ID and 450 mm OD, with inductances ranging from 1 mH to 500 mH.
Part of the optimisation process for the coils is achieving a particular contact resistivity $7.0 * 10^{-6}\ \Omega * m^2$. This resistivity value has been chosen to allow the magnet to be rapidly ramped down in case of an emergency. During coil testing, in addition to verifying critical current performance, we need to measure the sudden discharge time of the coils to verify the contact resistance we have achieved at 40 K. The combination of large inductance, relatively high contact resistance and low temperatures means there are particular difficulties associated with designing a suitable sudden discharge switch and measurement system.
Here, we will discuss the limitations of a contactor based switching system and describe the design of an alternative IGBT based system for performing sudden discharge measurements reliably in the presence of high voltage.
Following presentation of the design, we will detail coil testing progress for the coils we have wound to date for the REBCO MRI magnet.

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