**List of Figures:**

Figure 1.1: The resistance versus temperature for a non-superconductive metal and a perfect superconductor.

1

Figure 1.2: Resistance of mercury with respect to low temperature.

2

Figure 1.3: The Meissner effect: the expulsion of a weak, external magnetic field from the interior of a superconductor. The field is applied (a) at $T > T_c$ and (b) at $T < T_c$.

3

Figure 1.4: (a) electron density inside the superconductor, (b) the penetration of the magnetic field into the superconductor.

5

Figure 1.5: (a) Critical magnetic field as a function of temperature for Type-I superconductors, (b) the penetration depth and coherence length for Type-I superconductors.

1

Figure 1.6: (a) Critical magnetic field as a function of temperature for Type-II superconductors, (b) the penetration depth and coherence length for Type-II superconductors.

2

Figure 1.7: Illustration of superconducting critical surface.
Figure 1.8: Structure of $Y_1Ba_2Cu_3O_7$ compound.

Figure 1.9: The unit cell of Bi-2212. Bi-2201 has one less CuO$_2$ in the top and bottom half and no Ca layer of Bi-2212 unit cell while Bi-2223 has an extra CuO$_2$ and Ca layer in each half of Bi-2212 unit cell.

Figure 1.10: Schematic diagram of the ion beam assisted deposition (IBAD) system.

Figure 1.11: Schematic diagram of biaxially aligned YBCO coated conductor using an IBAD textured buffer layer.

Figure 1.12: Schematic of the Rolling-assisted biaxially-textured substrates (RABiTS) process.

Figure 1.13: Schematic representations of cross-sections of four RABiT multilayer structures, ML0, ML1, ML2 and ML3.

Figure 1.14: Sketch of pulsed laser deposition (PLD) process for fabricating YBCO superconductors.

Figure 1.15: (a) Schematic for deposition of precursor film using the BaF$_2$ process. (b) Schematic of typical oxifluoride decomposition / YBCO conversion
schedule used in the \textit{ex-situ} processing of YBCO conductors.

Figure 1.16: Schematic of steps during the TFA-process from the as-deposited precursor layer to the crystallized YBCO layer.

Figure 1.17: Schematic diagram of the powder in tube process for Bi-2212 and Bi-2223 wire or tape.

Figure 2.1: Schematic diagram of superconducting thin tape of finite length.

Figure 2.2: Temperature with respect to different times at different positions of the HTS tape.

Figure 2.3: Temperature with respect to different coordinates at different times of the HTS tape.

Figure 2.4: 3D representation of YBCO tape temperature distribution with respect to position coordinates and times.

Figure 2.5: Schematic diagram of YBCO wire of finite length.

Figure 2.6: Temperature with respect to time at different positions and radius of HTS wire.
Figure 2.7: 3D representation of YBCO wire temperature distribution with respect to position coordinates and times at $r = 0$.

Figure 2.8: Temperature with respect to time for complete cycle of HTS wire.

Figure 2.9: Schematic diagram of a long cylindrical wire.

Figure 2.10: Temperature of YBCO wire with respect to different times at different radial distances.

Figure 2.11: Temperature of YBCO conductor with respect to the radial distance for different times.

Figure 2.12: Temperature of YBCO wire at the center ($r = 0$) with respect to time for the different heat transfer coefficients.

Figure 2.13: Schematic diagram of YBCO thin tape of finite length.

Figure 2.14: Temperature of YBCO tape with respect to the position co-ordinates for different times.
Figure 2.15: Temperature along the length of YBCO tape for different generation for a given time period of $t = 2.0$ sec, excluding the both edges.

Figure 3.1: Soldering of voltage terminals with superconducting tape.

Figure 3.2: Data acquisition schematic for $I_c$ measurement.

Figure 3.3: Guarding Pattern in PCB layout.

Figure 3.4: PCB layout of signal conditioning card.

Figure 3.5: Schematic of YBCO tape with notations.

Figure 3.6: YBCO sample preparedness for twist experiment.

Figure 3.7: The experimental set-up for uniform twisting of the superconducting tape and its DATA acquisition during current ramp-up / ramp-down.

Figure 3.8: Image of YBCO tape at an experimental twisting angle of $990^\circ$.

Figure 3.9: Variation of torsional shear stress along the length of beam for the twist angle per unit length of 20 ($^\circ$/cm).

Figure 3.10: Twisting moment and shear stress for different twist angle per unit length.

Figure 3.11: FEA analysis of D-shaped magnet for (a) Induced self-filed profile, (b) line plot of field profile.

Figure 3.12: 3D modeling of D-shaped magnet along with its various dimensions.
Figure 3.13: Photograph of D-shaped BSCCO magnet wounded on SS 304 L structure.

Figure 3.14: Experimental set-up for D-shaped double pancake magnet characterization.

Figure 3.15: Photograph of the experimental set-up for D-shaped magnet characterization along with its DATA acquisition during current ramp-up / ramp-down.

Figure 3.16: Wiring configuration for Pt100 RTD temperature sensor.

Figure 3.17: Minimum quench energy measurement procedure.

Figure 4.1: I-V characteristics for (a) YBCO tape and (b) BSCCO tape.

Figure 4.2: Consolidated I-V characteristics of YBCO straight tape for various ramp-rates.

Figure 4.3: Consolidated I-V characteristics of BSCCO straight tape for various ramp-rates.

Figure 4.4: Consolidated I-V characteristic for twist angle 480° for various ramp-rates.

Figure 4.5: Consolidated I-V characteristic for twist angle 990° for various ramp-rates.

Figure 4.6: Consolidated I-V characteristic for twist angle 1260° for various ramp-rates.

Figure 4.7: Consolidated I-V characteristic for twist angle 1680° for various ramp-rates.

Figure 4.8: Behavior of normalized critical current $I_c/I_{c0}$ with respect to twist angle per unit length and shear strain in (%) for different ramp-rates.

Figure 4.9: Normalized $(n/n_0)$ behavior of YBCO tape for different twist angle per unit length.
Figure 4.10: SEM images of the twisted sample showing crack at the interlayer portion of the twisted sample.

Figure 4.11: I-V curve showing the hysteresis during the current ramp-up and ramp-down.

Figure 4.12: Normalized critical current values of D-shaped HTS magnet for different current ramp-rates under self-filed at 77 K.

Figure 4.13: Normalized critical current values of D-shape HTS magnet in perpendicular external magnetic fields at 77 K.

Figure 4.14: V(t) for quenches at 77 K, \( I_t / I_c = 0.65 \). The reference voltages along with the illustration of \( \Delta t \) for NZPV calculations.