Appendix

Control Instrumentation Division (CnID) BARC had been assigned the task of designing a prototype HTSC motor. As per the design requirement, a consignment of MTG components of hollow cylinder, plates and pins, was prepared by the top seeded melt texture growth (TSMTG) technique described in this thesis. The details of the supply are:

A.1 Supply of MTG components of different shapes:

A set of 30 pins of Y-123 oxide were fabricated using methods discussed in present thesis. Composite B powder was filled in mould size pins 1, compacted in CIP. All the 30 pins were sintered and subjected to TSMTG thermal schedule. After MTG, they were machined to 8 mm OD x 25 mm height and further subjected to annealing in oxygen atmosphere at 425°C for 150 h.

A set of 2 plates were fabricated. The composite B powder was filled in mould size Plate 1, compacted in CIP. Both the plates were sintered and subjected to MTG in identical condition of thermal schedule. The plates were machined to 3.5 mm thick x 25 mm length x 50 mm and further subjected to annealing in oxygen atmosphere at 425°C for 150 h.

A hollow cylinder was fabricated using composite B. The composite B powder was filled in the mould, compacted in CIP. The cylinder was then sintered and subjected to MTG thermal schedule. The cylinder was machined to 46 mm ID x 36 mm OD x 50 mm height and further subjected to annealing in oxygen at 425°C for 200 h.
A.2 Characterisation of MTG components

A.2.1 Levitation Force Measurement of YBCO Pins

TSMTG Pins were tested for levitation force before using in motor. The 8mm-dia x 25mm-long pins were bunched in 7 nos and 19 nos and immersed in liquid nitrogen in a thermocole container at zero field. A samarium cobalt permanent magnet fitted vertically in line with a loadcell was gradually approached to YBCO pins from the top. A fibre glass distance piece between magnet and loadcell isolates the load cell from thermal and magnetic field of superconductor. A 3-dimensional micrometer helps in positioning the magnet centrally over the pins and measuring the varied vertical distance of magnet from the pins. The levitation force measured at a distance of 1mm from magnet and pins for 7 pins bunched was found to be 16 N (Fig. A.1) and levitation force of 19 pins was found to be 34 N (Fig. A.2).

Fig. A.1 Levitation force measured at a distance of 1mm from magnet and pins for 7 pins bunched was found to be 17 N
Fig. A.2  Levitation force measured at a distance of 1mm from magnet and pins for 19 pins bunched was found to be 34 N

A.3 Application of MTG components as rotor in prototype HTSC motor

The MTG plates, pins and hollow cylinders were used in HTSC motor. Fig A.3, shows the schematic drawing of HTSC rotor, assembly of parts of rotor with HTSC plates and assembled rotor.

The schematic drawing of HTSC rotor, assembly of parts of rotor with HTSC pins and assembled rotor is shown in Fig. A.4.

The HTSC hollow cylinder fixed inside the rotor is shown in Fig.A.5. The assembled rotor fixed with HTSC cylinder is also shown in Fig.A.5

The picture of HTSC motor assembly is shown in Fig. A.6.
Fig. A.3 (A) Schematic drawing of rotor, (B) parts of rotor with HTSC plates, (C) assembled plate type rotor

Fig. A.4 (a) Schematic drawing of rotor, (b) parts of rotor with HTSC pins, (c) assembled pin type rotor
Fig. A.5 HTSC hollow cylinder fixed inside the rotor and assembly of hollow cylinder.

Fig. A.6 HTSC motor assembly.
A.4 Test report

Test Report of Motor with YBCO pins: From the testing report of Y-123 MTG
24 Nos. pins supplied to Control instrumentation Division, BARC, it was established that
the motor was working and exhibited flat torque characteristics up to synchronous
speed of 2900 rpm without load.

Fig.A-7 Levitating magnet on TSMTG pellet