

SUMMARY

A coated conductor is generally fabricated by depositing a high T_c superconducting layer onto a flexible metallic substrate, using intermediate buffer layers to prevent chemical interaction. In order for the superconductor to be capable of carrying a high current density, its grains must have good crystallographic alignment in order to avoid the presence of high angle grain boundaries. This can be ensured by transferring the texture from the substrate through epitaxial film growth.

The main substrate considered in this thesis is a Ni-Fe alloy. When cold-rolled, NiFe develops a preferential orientation and upon annealing at an elevated temperature, undergoes primary recrystallisation to form grains with the cube texture $\{100\}\langle 001\rangle$. The recrystallisation process and the texture of the tapes has been examined and various buffer layers have been fabricated. As silver does not react adversely with high temperature superconductors, it has been deposited onto Pd-buffered NiFe by DC sputtering and very sharp cube texture is obtained. Ceramic buffer layers, CeO_2 and YSZ, have been deposited by RF sputtering, though an undesirable (111) oriented component accompanies the cube textured material. Also a technique has been developed to produce a suitably oriented native oxide of NiFe by a simple oxidation technique. Preliminary attempts to deposit YBCO films onto these buffer layers have shown that the quality of the metallic buffers is degraded by rapid inter-diffusion at elevated temperatures, but that cube textured material can be deposited on the oxide buffer layers.

The percolative nature of current flow in such coated conductors has been considered through the development of a grain network model. As the texture of the superconducting layer is directly influenced by the underlying layers, measurements from the substrate and buffer layers are applied in order to model the orientations of the grains in a superconducting overlayer. The model calculates the critical current of coated conductors as a function of parameters such as length, width, grain size and texture, as well as examining factors such as cracks and highly misoriented grains.