Soon after Müller and Bednorz found superconductivity at temperatures above 30 K in perovskite related complex oxides, cuprate superconductors have been prepared with critical temperatures $T_c$ well above 77 K – the boiling point of liquid nitrogen. During the nineties three fundamental structural families of oxide superconductors have been found, including Bi, Tl or Hg based materials with $T_c$ up to about 130 K and rare earth barium cuprates with $T_c$ typically between 90 and 97 K.

Although the physical nature of this “high temperature” superconductivity is not completely understood this has not been an obstacle for technical application, because of certain unique properties which make them highly interesting from the technical point of view and very soon engineers started to investigate their technical potential.

Typically they were developed as bulk materials in form of cast semi products or well crystallized single domain blocks of sizes up to 100 mm edge length or more with multiple seeding.

While scientific attempts are now concentrating to make the new class of superconductors available in superconducting wires or tapes, the bulk materials are meanwhile on the way to technical applications. Their applications are based on the fascinating properties – carrying loss free high currents and the capability to trap extremely high magnetic fields. The largest potential is expected from the use of the bulk materials in inherently stable contact-less bearings, fault current limiters, and electrical machines. Magnetic bearings may be configured as linear transport devices or as a rotating device in high speed machines. Electrical machines benefit from the high potentials for shielding (flux concentration and reducing armature reaction) and flux trapping (in superconducting permanent magnets). Superconducting current limiters use the quenching effect thus commutating short circuit currents from a superconductor to a normal conductor. They have a key function for operation of complex grids for high performance energy supply.

Meanwhile, a vast amount of papers exist dealing with details of physics, preparation, technical aspects and application of bulk superconductors. A comprehensive synopsis considering these aspects and the interrelationship is still pending. Thus, the engineer or physicist who wants to solve a technical problem by application of the new class of materials meets certain barriers:
understanding the materials properties and specific features of processing and handling,
understanding electromagnetic features of superconductivity and appropriate physical models,
knowledge about methods of modelling which support optimal design of devices,
knowledge and experience about chemical and physico-chemical fundamentals.

On the other hand, the chemist often does not recognize the chances for an optimal design of the materials properties, missing certain fundamentals of engineering.

Therefore, the book will present an introduction into the chemical and the physical nature of the material and facilitate the understanding of the behavior of the superconductor under electric and magnetic field.

It is the intention of the authors to provide scientists and engineers interested in working on this interdisciplinary field with the knowledge covering the disciplines as concerned. In this context, interrelationships between chemistry, physics and engineering should find a careful consideration.