3d Investigation of Phase and Element Structures of $Nd_2Fe_{14}B$ Super Magnets

K. Tsyrulin[#1] und F. Reinauer[2], D. Goll[3], St. Schweizer[3]

1 Carl Zeiss Microscopy GmbH, Carl Zeiss Straße 56, D-73447 Oberkochen
2 AMETEK GmbH, EDAX Business Unit, Kreuzberger Ring 6, D-65205 Wiesbaden
3 Hochschule Aalen - Technik und Wissenschaft, Beethovenstraße 1, 73430 Aalen

Sintered $Nd_2Fe_{14}B$ compounds belong to the rare earth magnetic materials. They possess a ten time higher energy density as common AlNiCo or hard ferrite magnets. The material is built up by $Nd_2Fe_{14}B$ crystals. Between them are rare earth oxides and other compounds. A long known chemical property of rare earth oxides is the hygroscopic behaviour, the reaction humidity in air. This causes blooms and lifting of the $Nd_2Fe_{14}B$ crystals which leads to the damage of the materials and its characteristics.

The electron dispersive analysis (EDS) gives the possibility to locate the contribution of elements and phases in a material. The latest silicon drift detectors (SDD) Apollo series from EDAX allows a mapping in very short time. With this technology a mapping of a selected area can be done in a few minutes instead in overnight run in former times. This advantage allows the development of a 3d technique, which gives us valuable information into depth. The result can be put together in 3d data cube for further investigations in the 3rd dimension.

The Zeiss CrossBeam® line combines the focused-ion beam (FIB) with the electron beam technology. The system enables in situ ion-milling of sample surfaces. The multipurpose chamber with additional ports allows the full analytical flexibility for micro structural analysis. With this new technique an investigation of a sample can be done in a very easy and fast way into depth.

The combination of the ZEISS Auriga and the EDAX Apollo XL allows the investigation of the behaviour of $Nd_2Fe_{14}B$ magnets in three dimensions. The effect of air humidity and conditions during preparation of the Nd-magnets was examined. The build up of the 3d structure was reconstructed.