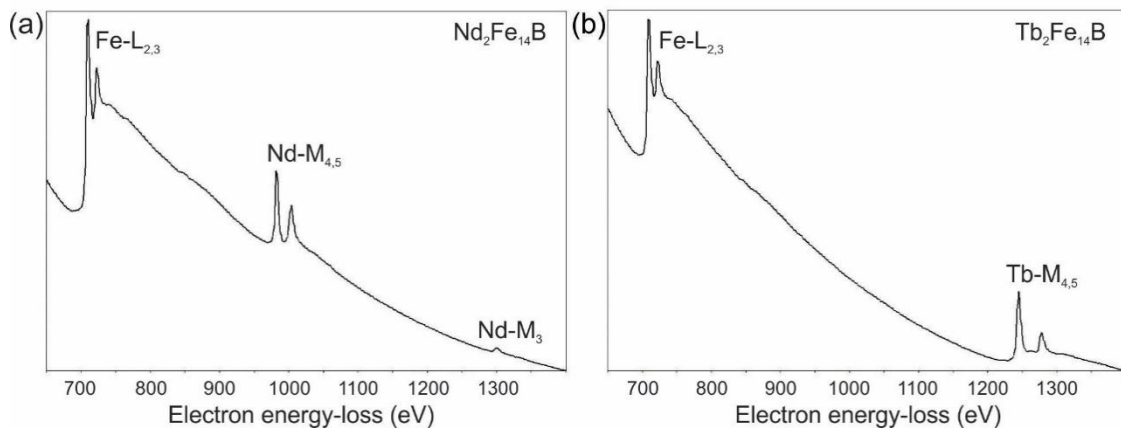


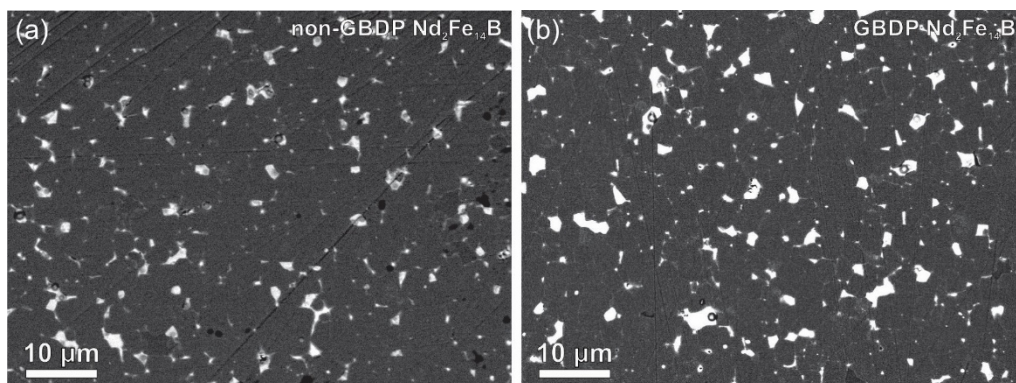
Supplementary material

Supplementary Fig. 1 shows EELS spectra for 1a $\text{Nd}_2\text{Fe}_{14}\text{B}$ and 1b $\text{Tb}_2\text{Fe}_{14}\text{B}$ standards.



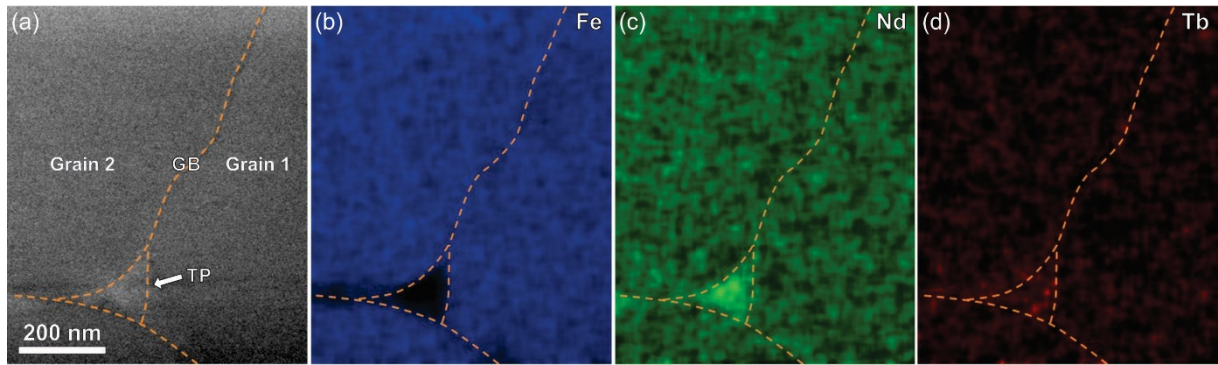
Supplementary figure 1. EELS spectra of (a) $\text{Nd}_2\text{Fe}_{14}\text{B}$ and (b) $\text{Tb}_2\text{Fe}_{14}\text{B}$ standard.

Supplementary Fig. 2 shows BSE-SEM images of *non-GBDP Nd-Fe-B* magnet and the 3rd slice of the *GBDP Nd-Fe-B* magnet. It can be seen that no significant differences in the overall microstructure between them can be observed using the SEM.



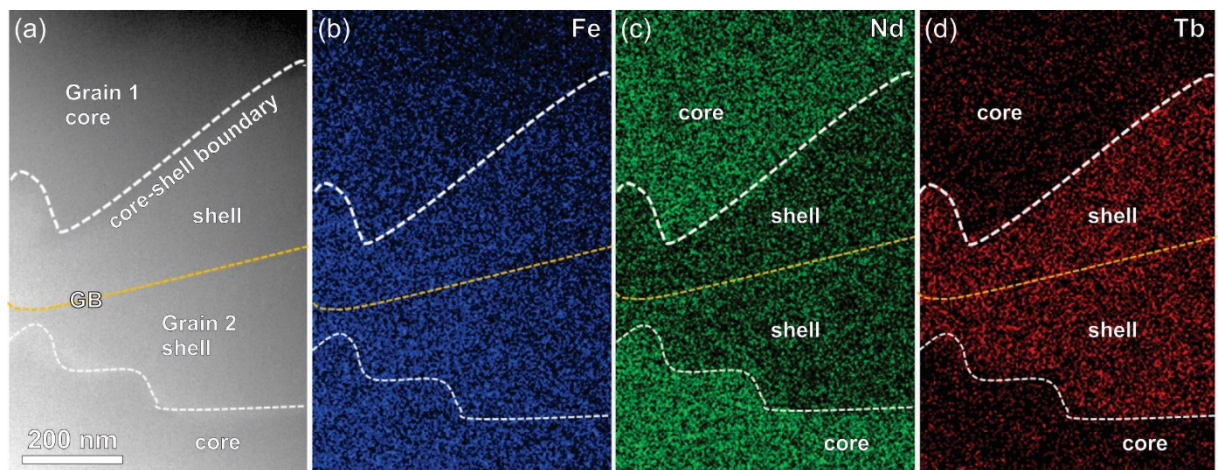
Supplementary figure 2. BSE-SEM images of (a) *non-GBDP Nd-Fe-B* magnet and (b) 3rd slice of the *GBDP Nd-Fe-B* magnet.

Supplementary Fig. 3a shows HAADF-STEM image from the central part of *GBDP Nd-Fe-B* magnet. It represents three grains separated by GB and a triple pocket. Supplementary Fig. 3b-d shows compositional maps extracted from EDXS spectrum images using Fe-K, Nd-L and Tb-M signals, respectively. The concentration of the elements in each grain is homogenous, indicating that the Tb diffusion did not form a well-define shell inside the grain. The Nd/Tb enrichment and Fe depletion are observed in the triple pocket.



Supplementary figure 3. (a) HAADF-STEM image from the central region of *GBDP Nd-Fe-B* magnet (ROI 4). (b-d) Corresponding elemental maps extracted from EDXS spectrum imaging in STEM mode using Fe-K, Nd-L and Tb-M lines, respectively.

Supplementary Fig. 4 shows a representative HAADF-STEM image with the corresponding EDXS-SI from the core-shell region for the two adjacent matrix grains separated by a grain boundary (GB) from the ROI 3. The EDXS spectrum images reveal that the Fe signal is homogeneously distributed throughout the whole analysed region. In contrast, the regions close to the GB are represented by the high Tb-M and low Nd-L signals, which indicates a Tb-rich shell, while the absence of a Tb signal and high Nd signal characterizes the core region of the matrix grain. The white dashed lines indicate the boundary between the Tb-rich shell and the Nd-Fe-B core.



Supplementary figure 4. (a) HAADF-STEM image of core/shells at a grain boundary region extracted from ROI 3 of *GBDP Nd-Fe-B* magnet. (b-d) Corresponding elemental maps extracted from EDXS spectrum imaging in STEM mode using Fe-K, Nd-L and Tb-M lines, respectively.