

Supplementary information

Nanocrystalline Nd-Fe-B anisotropic magnets by flash spark plasma sintering

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Starting materials

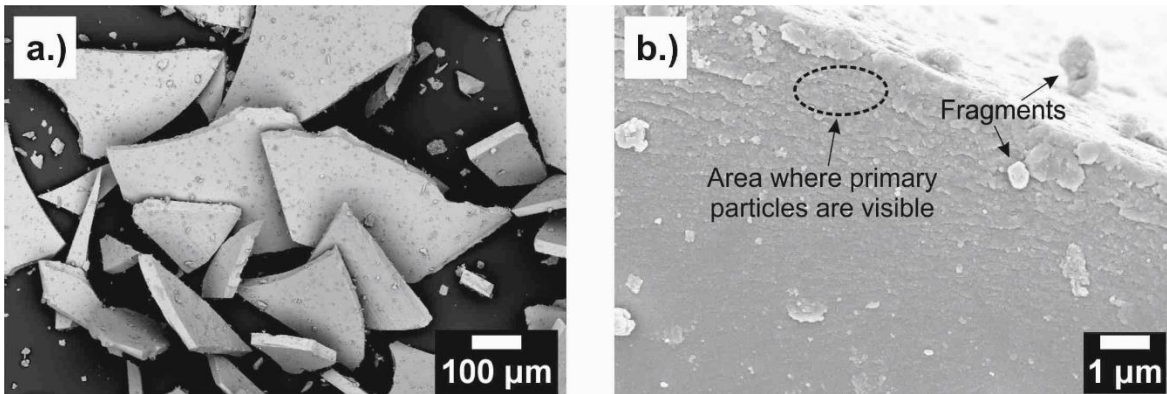


Figure S1: Melt-spun and grinded Nd-Fe-B powder **a.)** Flake-like powder morphology with fragments from grinding adhering on the surface **b.)** Fractured surface of a flake: Fragments from grinding and primary Nd-Fe-B particles can be distinguished.

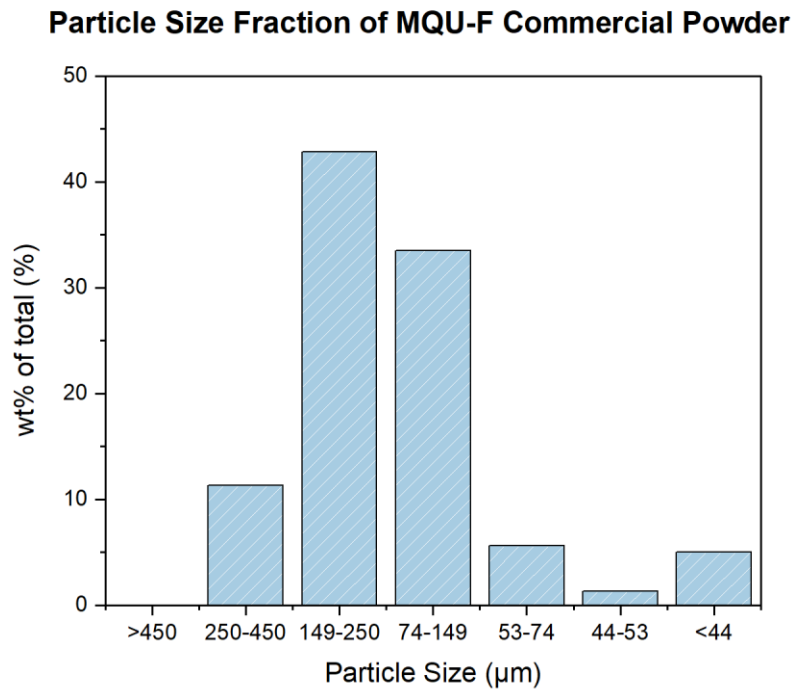


Figure S2: Particle size distribution of the MQU-F starting powder.

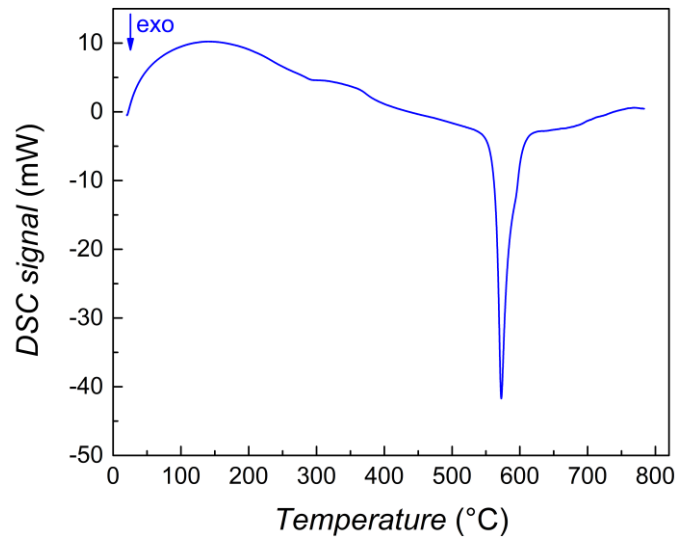


Figure S3: DSC measurement of the starting powder.

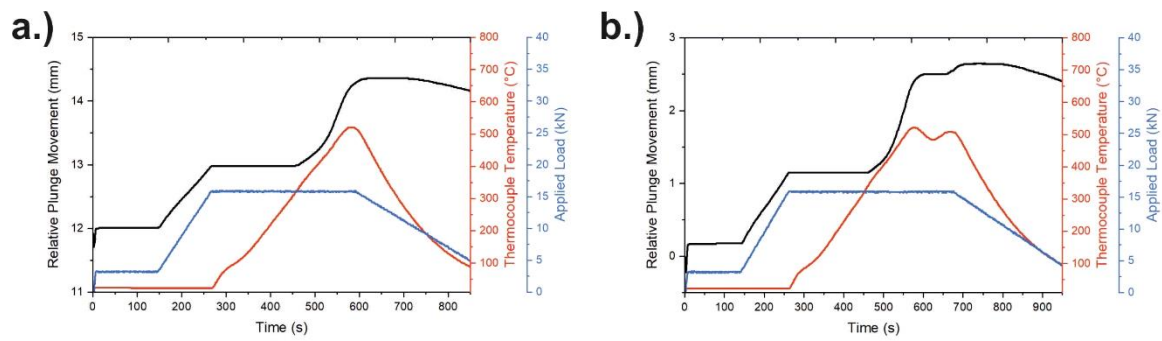


Figure S4: Load-temperature-displacement curves of samples pre-sintered via FAST/SPS at 500°C, 50 MPa **a.)** dwell time 30 s **b.)** dwell time 120 s.



Figure S5: Appearance of the Nd-Fe-B compacts before and after Flash SPS. Due to conducting the Flash SPS cycles without an outer die, the edge of the samples was frayed.

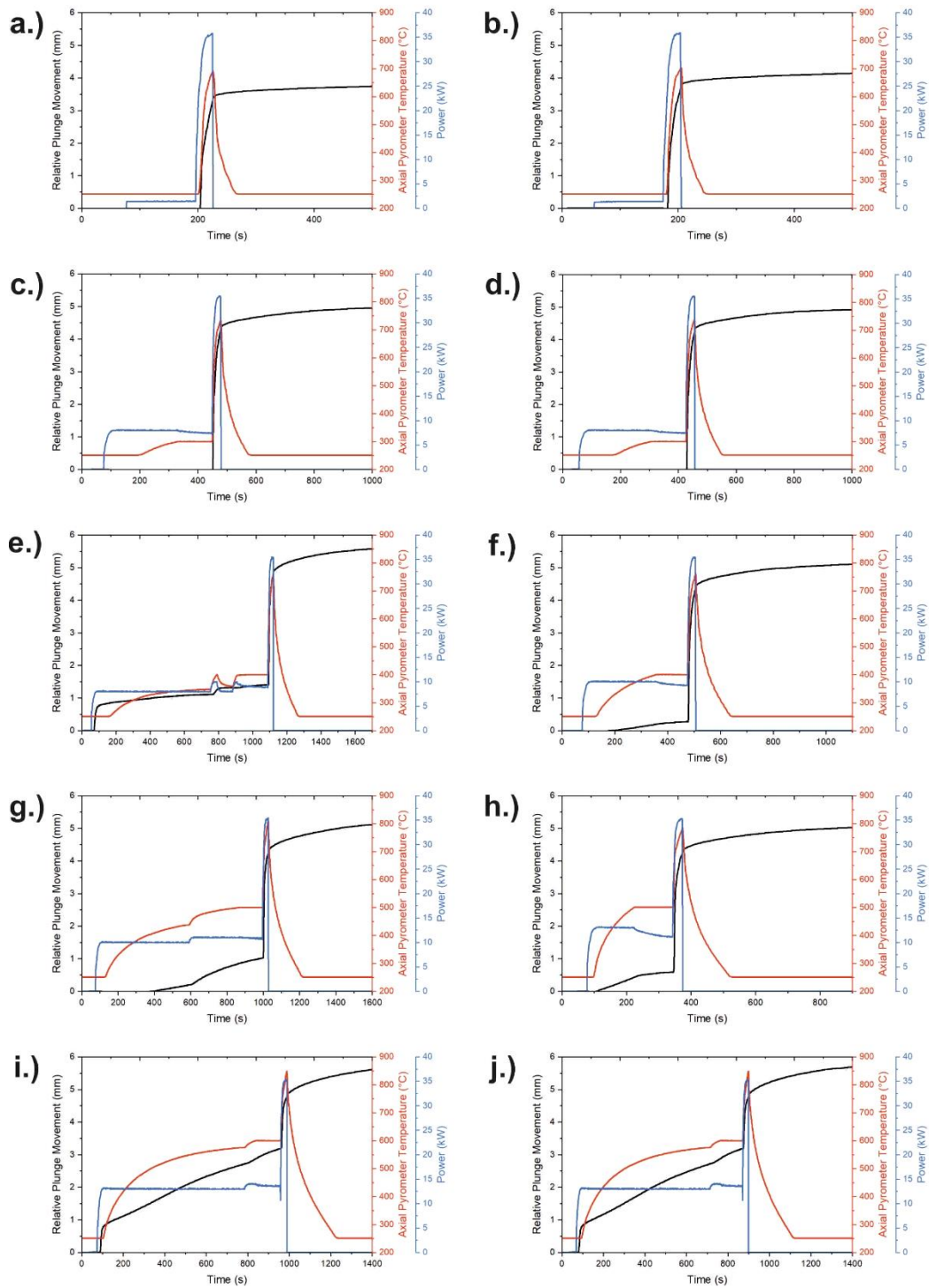


Figure S6: Comparison of Flash SPS cycles: Temperature-power-displacement curves as function of time during pre-heating and subsequent application of the power pulse **a.)** A-30_251 **b.)** B-120_251 **c.)** A-30_300 **d.)** B-120_300 **e.)** A-30_400 **f.)** B-120_400 **g.)** A-30_500 **h.)** B-120_500 **i.)** A-30_600 **j.)** B-120_600.

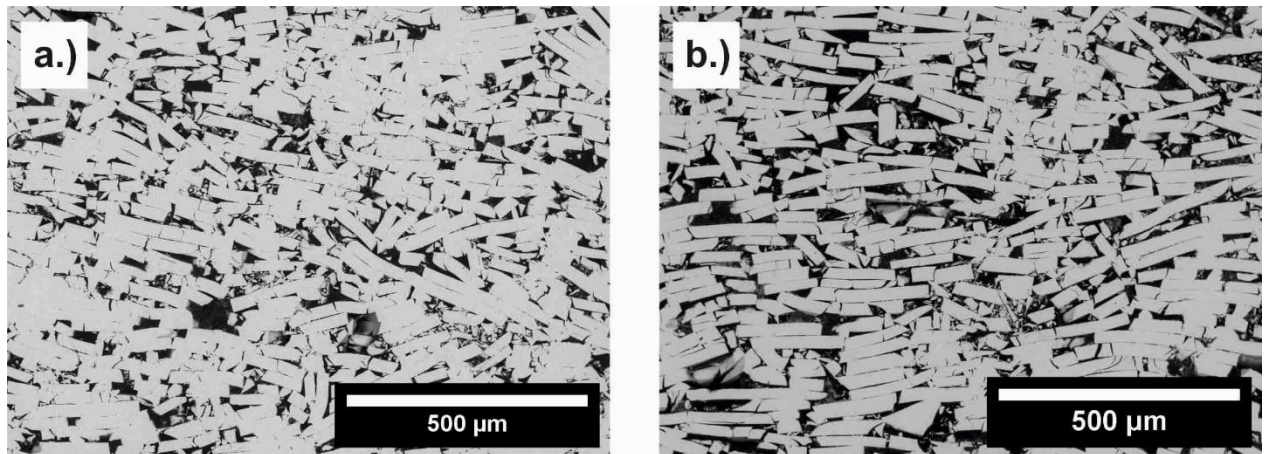


Figure S7: Microstructure of a compact pre-sintered via FAST/SPS at 500°C **a.)** Dwell time 30 s **b.)** Dwell time 120 s. Tilting of powder flakes leads to scattering of porosity in the pre-sintered state.

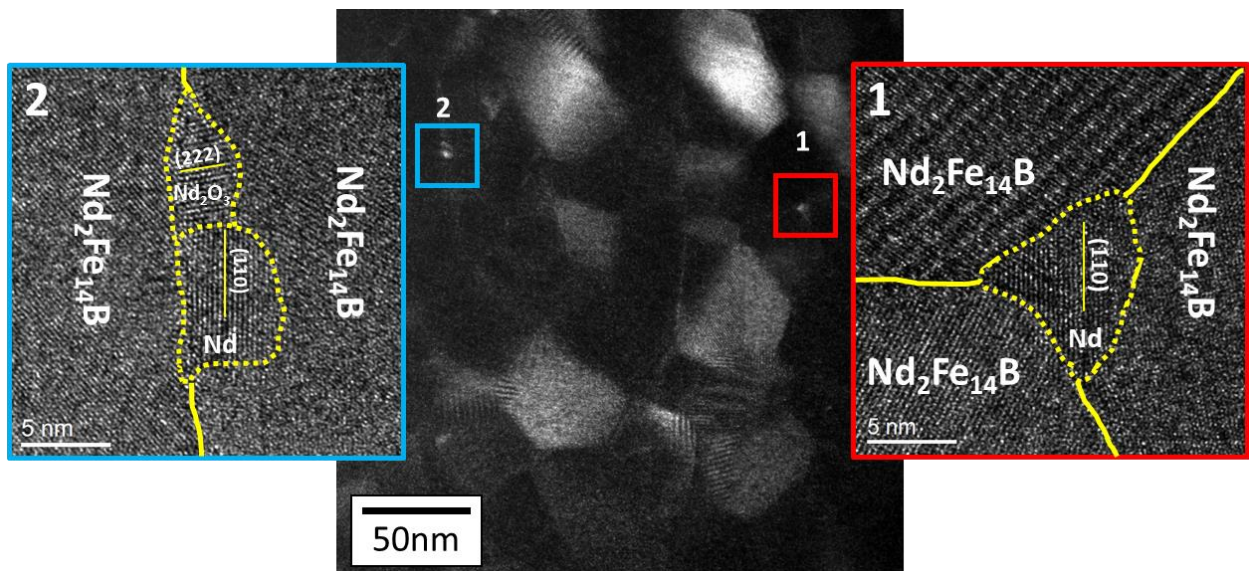


Figure S8: Dark field TEM image of a compact pre-sintered via FAST/SPS at 500°C for 120 s. The selected areas 1 and 2 show high-resolution TEM images with the corresponding phases. On position 1, we observe a triple junction with Nd-dhcp phase (double hcp structure - labelled as Nd) and on position 2, we observe a grain boundary phase containing Nd-dhcp and Nd_2O_3 . Grain boundaries and phase boundaries are highlighted, as well as the orientation of the Nd-rich phases.