

Synthesis of rare earth free permanent magnets by spark plasma sintering

Wednesday, 2 September 2026 11:40 (20 minutes)

High-performance rare earth based permanent magnets such as NdFeB and low-performance ferrite magnets currently dominate industrial applications. However, the development of hard magnetic materials free from critical raw elements while maintaining superior magnetic performance remains a key challenge.

The widely established route for producing NdFeB-type magnets is the liquid phase sintering of previously compacted green bodies, consisting of monocrystalline NdFeB particles. The alternative route of producing polycrystalline NdFeB particles by melt spinning technique is well known, but so far mainly used for producing polymer bonded magnets.

With respect to rare earth free hard magnetic materials, the synthesis is often not possible by conventional liquid phase sintering. Therefore, the focus is moved towards alternative sintering processes, which offer a higher potential of successfully producing these materials on a bulk scale. We present results for rare earth free permanent magnets, namely Fe₂P- and MnAl-based compositions, which were produced by melt spinning technique, subsequently ball milled to polycrystalline powders and finally densified by spark plasma sintering. We investigated the effects of melt spinning, ball milling and spark plasma sintering on microstructure and magnetic performance, in order to evaluate the potential for such materials synthesized with these processes.

Professional Status of the Speaker

Senior Scientist

Interest in submitting a paper in a special issue of

Advanced Engineering Materials (Wiley)

Invitation letter for visa

No

Author: DIEHL, Oliver (Fraunhofer Research Institution for Materials Recycling and Resource Strategies IWKS)

Co-authors: MENSCHOW, Markus (Fraunhofer Research Institution for Materials Recycling and Resource Strategies IWKS); Dr RADULOV, Iliya (Fraunhofer Research Institution for Materials Recycling and Resource Strategies IWKS); Dr SCHÖNFELDT, Mario (Fraunhofer Research Institution for Materials Recycling and Resource Strategies IWKS); Prof. GUTFLEISCH, Oliver (TU Darmstadt, Department of Materials and Geosciences, Functional Materials)

Presenter: DIEHL, Oliver (Fraunhofer Research Institution for Materials Recycling and Resource Strategies IWKS)

Session Classification: Field assisted sintering technology/Spark Plasma Sintering FAST/SPS

Track Classification: Group 3: Field assisted sintering technology/Spark Plasma Sintering FAST/SPS