Microstructural anisotropy of ferritic ODS alloys after different production routes

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Abstract

Concepts for future generation fusion reactors have demanding requirements for the structural materials. High neutron doses and elevated temperatures form a harsh environment in which present commercially available materials cannot be used. A new class of oxide dispersion strengthened (ODS-) materials which are currently being developed have a high chance of meeting these requirements.
The application of ODS steels as functional or structural application strongly depends on the availability of large batches of materials. Since no commercial ODS-alloys are available at the moment, investigations on large scale batches are crucial for future applications.
In this study, a batch of 10 kg ferritic steel powder (Fe-13Cr-1W-0.3Ti) was mechanically alloyed in a semi-industrial attritor ball mill with Fe_2Y intermetallic powder. Batches of 3-4 kg with different powder particle size distributions were canned in stainless steel containers and compacted by hot-isostatic-pressing (HIP) and hot-extrusion. A thermo-mechanical treatment including hot rolling and annealing was performed for the as-HIPed alloys afterwards.
The effects of powder particle size distribution on the microstructural properties were studied by scanning electron microscopy with electron backscatter diffraction. Although a homogeneous and fine grain size distribution was achieved after rolling, areas with different amounts of deformation were found. Microstructural properties and anisotropy effects are correlated to Charpy-impact tests. The materials after rolling shows a DBBT well below -50°C with excellent impact energies. Detailed investigations on the crystallographic textures concluded the work.