# Microstructure and Soft Magnetic Properties Evolution Versus Milling Conditions for FINEMET Submicron Powders

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The aim of this work was to prepare FINEMET powders by ball milling annealed precursor melt-spun ribbons (MSRs), and to study the influence of ball-milling parameters upon the evolution of their microstructure and magnetic stability. Two different surfactants were used as milling agents to compare wet and dry milling environments: oleic acid (OA) for wet milling, and stearic acid (SA) for dry milling. Ribbons were annealed at 420ºC and 450ºC for 1 h, and ball milled for 24, 48 and 72 h. Hysteresis loops show that the specific magnetization remains largely constant for powders milled in OA, while in SA the specific magnetization decreases with milling time. After 72 h milling in OA, the saturation magnetization remains close to that of the precursor ribbons, at approximately 145 $Am^2/kg$, while for powders milled in SA it decreases to approximately 85 $Am^2/kg$. Microstructural investigation using TEM shows that powder particles milled in OA are non-agglomerated particles with a platelet morphology, while those milled in SA consist of a large density of much smaller particles compacted into more round agglomerates. For milling times of 48 and 72 h, powders milled in OA and SA both consist of an α-Fe(Si) nanocrystalline phase embedded in an amorphous matrix. The size of nanograins is independent of milling conditions and within the range 3.8 – 6.0 nm; however, the number of powder particles containing nanograins increases with milling time. The improved soft magnetic properties of powders milled in OA are largely due to the effect of the wet milling environment which leads to less oxidation than milling in SA.
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