Abstract SMM 2022: 25th Soft Magnetic Materials Conference, 2-5 May, Grenoble, France

Material investigation for the next generation electrical traction machines (invited)

Sigrid Jacobs,
Expert for Electrical Steels, ArcelorMittal Global R&D, Zwijnaarde, Belgium

The electrification of transport powertrains is the consequence of worldwide sustainability targets. In Europe the Green Deal and the propositions Fit for 55, presented by the Commission in July '21, include a more stringent legislation with a more ambitious CO2 emission reduction target and an objective to phase out internal combustion engines in 2035. The electrification of transport powertrains is not only steered by sustainability targets, but also by efficient management of the critical raw materials, that are used for generating the magnetic fluxes in in the airgap. ArcelorMittal is a longstanding supplier of electrical steels for high efficiency electrical machine in many applications, and has been accompanying the specific needs of electric traction machines with dedicated electrical steel grades, as soon as electrification of electric vehicles started being developed. Its electrical steel product range branding helped shaping the standardisation of electrical steels for medium frequency applications. Furthermore, ArcelorMittal has branded its ongoing global program of steelmaking innovation targeted at carbon neutral steel by 2050, as XCarb™. The optimisation objectives for automotive traction machines still are: power density, performance over the drive cycle and efficiency for extended drive ranges. However these have been complemented by a minimisation of the use of critical raw materials. Over the last 20y the permanent magnet synchronous machines have been strongly improved and have integrated aspects of reluctance torque maximisation, for optimal torque density. Rotor speeds were increased, to maximise power density. In parallel induction machines have been optimised for traction powertrains, as alternative without critical raw materials, for a.o. also their excellent overloadability, despite a lower power density. The battery energy supply has remained the critical design parameter, for the achievable drive range. E-machine efficiency remains a top priority, to achieve a long drive range. Many e-machine topologies have been revisited for performance improvements, of which we have selected two advanced, emerging technology optimisations. The new topologies require an in depth review of active material choices. In particular, the influence of the properties of the ferromagnetic material, is relevant, for each machine type.