Advanced electrical steels for electric motors of next-generation EV/HEV applications

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Electric and hybrid electric vehicles (EV/HEV) is of major importance for OEMs in light of upcoming emission legislations. Almost every automotive manufacturer has active EV/HEV development programmes and the amount of H/EV on the market is rapidly increasing. Key enablers of EV/HEVs are electric traction motors and high-capacity battery packs.

High cost and weight of batteries places high demand on electric traction motor designs, especially on their efficiency. EV/HEV developers have been focusing on developing advanced electric motors of high power and torque densities whilst maintaining or increasing its efficiency. This requires motors to run well above 15,000 rpm, increasing overall drive train efficiency offsetting high battery weight and costs. Ultra-thin electrical steels with high permeability and low iron losses are materials of choice for motors’ stator and rotor cores to meet these requirements.

However, increased e-motor performances are putting increasing demands on electrical steel magnetic properties and power loss levels. At the same time, electrical steels are also required to surpass the mechanical and fatigue requirements associated with higher rotational speeds. High efficiency demands that ever thinner electrical steel are developed to meet the magnetic & mechanical requirements enabling higher rotor speeds and switching frequencies.

In this paper, the author intends to provide an overview of the latest development in non-grain oriented electrical steels for EV/HEV application, developed by Tata Steel and its subsidiary Cogent Power. Particular attention will be put on ultra-thin electrical steels with guaranteed mechanical and magnetic properties. Examples of applications of these products in high-performance EV/HEV motors is supported by rigorous structural and durability assessments. This showcases that these electrical steels not only have excellent magnetic properties and lower iron losses at high speeds, but also exhibit mechanical and fatigue performance to meet the durability requirements.