

超导电动磁浮技术完善交通系统产业链

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超导电动磁浮技术是地面高速及超高速交通的重要战略选择之一,它具有高效便捷、安全可靠、节能环保、智能舒适等优势,适用于地面线、隧道线以及低真空管道等多种应用场景。因此,超导电动磁浮技术被认为是当前世界轨道交通技术的“制高点”之一。超导电动磁浮交通系统是未来我国构建超大城市、发达经济圈之间快速运输通道的重要选择,也能为优化国土空间布局、推进区域协调发展、加快我国综合立体交通网建设提供重要支撑。

为贯彻落实习近平总书记在视察中车长春轨道客车股份有限公司(以下简称“中车长客”)时作出的重要指示精神,加快自主创新步伐,保持我国在轨道交通领域的领先领跑地位,作为我国交通装备制造领域的领军企业,中车长客在磁浮领域厚积薄发、深耕不辍,经过三十余年的积累,取得了丰硕的科研成果,于2024年7月发布了我国首台超导电动磁浮试验样车。

中车长客自主研发的超导电动磁浮试验样车搭载碳纤维复合材料车体、多模式铰接悬浮架、全尺寸高温超导磁体、车载低温制冷系统和感应供电系统,有力推进了磁浮交通技术的自主创新和工程化,同时对超导材料、直线牵引、低温制冷、真空保持等产业链实现横向覆盖,从而为高速轨道交通技术持续领先领跑注入新动能。

中车长客的超导电动磁浮试验样车具有下列特点和优势:

高效便捷。超导电动磁浮悬浮导向间隙大、车轨耦合作用更低、对轨道不平顺敏感性更低、提速空间广,最高运营速度可达600 km/h,填补了高铁和飞机之间的速度空白,以更高速度等级解决方案助力我国立体交通网搭建,提升城市群联动发展效能。

安全可靠。车辆始终在U型半包围轨道梁之内运行,无脱轨风险;车载磁体通过与轨旁悬浮线圈的电磁感应,使列车克服重力悬浮于U型轨道中,实现被动自稳定悬浮,极大提升了系统可靠性。

节能环保。车辆悬浮走行系统超导状态下磁体无电阻损耗,电流在超导线圈内闭环运行,无需外接励磁电源,具备小时级全断电运行能力,高速运行能耗低;采用高温超导材料,无需消耗国内稀缺的液氮资源;整车采用流线型外观,气动阻力小;结构设计采用碳纤维等新材料,既实现了车体轻量化,又能满足高气动载荷需求。

智能舒适。超导电动磁浮采用最高等级自动化驾驶技术,具备常规、降级、应急等多重运行模式;同时,车辆采用5G车-地通信技术,搭载多媒体调度指挥、运行状态监控等系统,传输速度快,抗干扰能力强;无级调节人机工程学造型座椅,保证舒适性,提升出行体验。

面向未来,必须引领发展战略性新兴产业,加快形成新质生产力。党的二十届三中全会将高质量发展摆在更加核心的位置,着眼于科技创新和产业创新深度融合,培育壮大新兴产业,布局建设未来产业。中车长客将充分发挥企业创新主体的作用与优势,胸怀“国之大者”,坚持“四个面向”,以高标准、高质量落实国家科技创新政策为行动指南,坚持产学研用合作,加快磁浮产业布局,使高速磁浮技术能为我国高效综合立体交通网的建设不断贡献新质力量!



Superconducting Electric Maglev Technology Enhancing Transportation System Industry Chain

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Superconducting electric maglev (SEM) technology is one of the key strategic options for ground-based high-speed and ultra-high-speed transportation. It offers advantages such as efficiency, convenience, safety, reliability, energy efficiency, environmental friendliness, intelligence, and comfort. This technology is adaptable to various scenarios, including ground lines, tunnel lines, and low-vacuum pipelines. As such, SEM technology is regarded as one of the 'commanding high grounds' of global rail transit technology. SEM transportation system is an essential choice for building rapid transport channels between megacities and advanced economic zones in China. It also provides critical support for optimizing national spatial planning, promoting regional coordinated development, and accelerating the construction of an integrated and multi-dimensional transportation network.

To implement the important directives given by General Secretary Xi Jinping during his visit to CRRC Changchun Railway Vehicles Co., Ltd. (hereinafter as 'CRRC Changchun'), and to accelerate independent innovation while maintaining China's leadership in the rail transit sector, CRRC Changchun, as a leading enterprise in the transportation equipment manufacturing field in China, has made fruitful advancements in the maglev domain after comprehensive preparation. With over three decades of accumulated expertise, CRRC Changchun achieved remarkable scientific research and development results, culminating in the release of China's first SEM prototype vehicle in July 2024.

The independently developed SEM prototype vehicle by CRRC Changchun features a carbon-fiber composite body, multi-mode articulated suspension framework, full-scale high-temperature superconducting magnets, an onboard cryogenic refrigeration system, and an induction power supply system. This innovation significantly advances independent innovation and engineering in maglev transportation technology. Moreover, it fosters horizontal integration across the industry chain, including superconducting materials, linear traction, cryogenic refrigeration, and vacuum maintenance, injecting new momentum into sustaining leadership in high-speed rail transportation technology.

CRRC Changchun's SEM prototype vehicle has the following features and merits:

Efficiency and Convenience. The SEM vehicle features a large suspension guidance gap, reduced vehicle-track coupling force, and lower sensitivity to track irregularities, providing significant speed enhancement potential, with a maximum operating speed of 600 km/h, which bridges the speed gap between high-speed railway and airplanes. This higher speed level solution supports the construction of China's multi-dimensional transportation network and enhances the collaborative development efficiency of urban clusters.

Safety and Reliability. The vehicle operates entirely within a U-shaped semi-enclosed track beam, eliminating derailment risks. Its onboard magnets, through electromagnetic induction with trackside suspension coils, counteract gravity to achieve passive self-stabilizing suspension within the U-shaped track, which greatly enhances system reliability.

Energy Efficiency and Environmental Friendliness. In the superconducting state, the vehicle's suspension and propulsion system has no resistance losses, with electric currents circulating within the superconducting coils in a closed loop without external excitation power, enabling operation for hours during power outages and ensuring low energy consumption at high speeds. The use of high-temperature superconducting materials eliminates reliance on scarce domestic liquid helium resource. The streamlined vehicle exterior profile design minimizes aerodynamic drag, and the structure incorporates new materials like carbon fiber, achieving lightweight construction while meeting high aerodynamic load demands.

Intelligence and Comfort. The SEM system utilizes top-tier automated driving technology with multiple operational modes, including standard, degraded, and emergency modes. Meanwhile, the vehicle incorporates 5G vehicle-wayside communication technology, bearing subsystems including multimedia dispatch and coordination, operational state monitoring, with fast data transmission speed and strong interference-resistant capability. The vehicle also features ergonomically adjustable seats with seamless controls, ensuring comfort and enhancing the passenger experience.

Looking ahead, it is essential to lead the development of strategic emerging industries and accelerate the creation of new productive forces. The Third Plenary Session of the 20th CPC Central Committee places high-quality development in more pivotal position, focusing on deeply integrating technological and industrial innovation, fostering emerging industries, and planning for future industries. CRRC Changchun will fully leverage its position as a leading enterprise in innovation, uphold principles regarding 'matters of national significance', devote to the 'Four Orientations' strategic guidelines, and implement national technological innovation policies with high standards and quality. Through collaboration across industry-academia-research-application, CRRC Changchun is accelerating its maglev industry initiatives, aiming to ensure that high-speed maglev technology continues to contribute transformative power to the construction of efficient, integrated, and multi-dimensional transportation network in China!

Translated by ZHANG Liman