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Mon-Mo-Po1.10-07 [115]: Design and optimization of closed-loop NI-HTS coils for a prototype EDS-Maglev system

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Recently non-insulation (NI) HTS coils using coated conductors (CCs) draw extensive attention because of their self-protecting capability. Closed-loop coils are also promising in the application of electrodynamic-suspension (EDS) Maglev train with superconducting magnets since the heat load of the on-board magnet can be significantly reduced, typically >50%. Therefore, closed-loop NI-HTS coils are proposed to be employed in our prototype EDS-Maglev system.

Several key points on the coil design/optimization are considered and supposed to be presented: (1) Topological structure. Each on-board magnet has at least one pair of N-S poles. Each pole is composed of several, typically 4-8, double-pancake coils with a race-track shape. The optimization target is to use the least number of joints between and inside these coils and poles, especially bridge-type joints which usually are with high resistances. (2) Turn-to-turn contact resistance, which is mainly determined by the material of stabilizer layer and the contact pressure. These two factors are ex-situ studied experimentally with short CC tapes and verified in a practical coil; (3) The normal-state resistance of the PCS, which is determined by its operation temperature, the tape length and also by the material of stabilizer layer. Actually this factor has a similar influence on the charging speed as the turn-to-turn contact resistance. Therefore "how large it should be"is analyzed in the same circuit model. And then we achieve it according to our experimental study on temperature and material of stabilizer layer. (4) The decay rate. Our target is less than 1%/day. This is important for the daily operation of a real maglev train and mainly determined by the joint resistance as well as the topological structure (inductance, joint number and type), if not considering the influence of external AC magnetic field. (5) The bobbin structure. With an optimized structure, the turn-to-turn contact pressure can be controlled with an acceptable precision. Also the coils are hoped to be bonded to the bobbin with practical insulation and thermal conductance simultaneously.

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