Маглев. Часть 8. Магнитолевитационный транспорт

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Аннотированный список литературы 32 наименования

1 Safaei F., Suratgar A. A., Afshar A., Mirsalim M.

Оптимизация характеристик системы гибридного магнитного подвеса транспортного средства с использованием генетического алгоритма. Characteristics optimization of the Maglev train hybrid suspension system using genetic algorithm. IEEE Trans. Energy Convers.. 2015. 30, N 3, с. 1163-1170. Англ.

Рассмотрены вопросы оптимального проектирования конструкции гибридного электромагнитного подвеса на постоянных магнитах транспортного средства с системой левитации в целях минимизации потерь мощности. Выведено нелинейное соотношение для магнитной силы на основе разработанной схемы замещения магнитной цепи подвеса с гибридной структурой. Представлена аналитическая основа, учитывающая магнитный поток рассеяния и свойства материалов. Предложен ряд конструктивных решений для достижения практических результатов. С использованием генетического алгоритма оптимизирована поддерживающая сила при минимизации потерь мощности. Посредством 3-D конечно-элементного анализа установлена достоверность результатов, полученных на основе реализованной модели, продемонстрированы преимущества последней. Показано, что предлагаемое техническое решение позволяет увеличить магнитную силу при значительном сокращении потерь мощности по сравнению с традиционными электромагнитными и ранее созданными гибридными конструкциями.

Рубрики: 45.53.37; 451.53.37.29.35.31

2017-05 EL08 БД ВИНИТИ

2 Zhou Dajin, Cui Chenyu, Zhao Lifeng, Zhang Yong, Wang Xiqing, Zhao Yong

Стабильность значений управляющей силы в электромагнитном подвесе с использованием высокотемпературных сверхпроводников в статическом и динамическом режимах. Static and dynamic stability of the guidance force in a side-suspended HTS maglev system. Supercond. Sci. and Technol.. 2017. 30, N 2, с. 025019. Англ.

Проанализированы выполненные теоретические и экспериментальные исследования силы, действующей в устройстве электромагнитного подвеса (УЭМП) с сверхпроводящей системы, использующей высокотемпературные сверхпроводниковые провода (СП) на основе соединения YBCO. Показано, что в рассматриваемой системе действуют два вида направляющих сил, на величину которых оказывает влияние размер зазора в УЭИП и размещение СП относительно центральной оси этого устройства. Функционирование оптимизированной структуры данной сверхпроводящей системы проверено экспериментально при испытании механизма с УЭМП в статическом режиме и при его движении с линейной скоростью 102 км/ч по круговой траектории диаметром 6,5 м.

Рубрики: 45.31.31; 451.31.31.27.33

2017-06 EL02 БД ВИНИТИ

3 Deng Z., Zhang W., Zheng J., Ren Y., Jiang D., Zheng X., Zhang J., Gao P., Lin Q., Song B., Deng C.

Кольцевая экспериментальная линия магнитной левитации на высокотемпературных сверхпроводниках, сооруженная в Чанду, Китай. A High-Temperature Superconducting Maglev Ring Test Line Developed in Chengdu, China. IEEE Trans. Appl. Supercond.. 2016. 26, N 6. Англ.

В 2013 г в Чанду (Китай) была построена экспериментальная кольцевая линия (длиной 45 м) с магнитной левитацией на высокотемпературных сверхпроводниках. Транспортное средство на магнитной подушке (длиной 2,2 м, шириной 1,1 м, при высоте левитации 10-20 мм) разработано для одного пассажира. Направляющая постоянных магнитов (при длине 45 м и ширине колеи 0,77 м) имеет форму рейс-трека с радиусом кривизны 6 м. Движение реализуется линейным асинхронным двигателем с максимальной скоростью 50 км/ч. Линейный двигатель состоит из четырех индукторов, установленных в середине сдвоенных направляющих для постоянных магнитов. Общая длина составляет 3 м. Основное внимание в системе транспортных средств на магнитной подушке второго поколения уделено стоимостным характеристикам и функции беспроводного многопараметрического бортового мониторинга. Нагрузочная способность при одном и том же уровне тока достигается при более низкой стоимости и меньшем поперечном сечении зоны направляющих, равном всего 3000 мм2. Детально рассмотрены элементы и узлы системы, представлены результаты испытаний.

Рубрики: 45.53.37; 451.53.37.29.35.31

2017-12 EL08 БД ВИНИТИ

4 Zheng Jun, Zheng Botian, He Dabo, Sun Ruixue, Deng Zigang, Xu Xun, Dou Shixue

Магнитные и левитационные характеристики объемных высокотемпературных сверхпроводящих магнитов над направляющей поверхностью постоянного магнита. Magnetic and levitation characteristics of bulk high-temperature superconducting magnets above a permanent magnet guideway. Supercond. Sci. and Technol.. 2016. 29, N 9, с. 095009. Англ.

Due to the large levitation force or the large guidance force of bulk high-temperature superconducting magnets (BHTSMs) above a permanent magnet guideway (PMG), it is reasonable to employ pre-magnetized BHTSMs to replace applied-magnetic-field-cooled superconductors in a maglev system. There are two combination modes between the BHTSM and the PMG, distinguished by the different directions of the magnetization. One is the S-S pole mode, and the other is the S-N pole mode combined with a unimodal PMG segment. A multi-point magnetic field measurement platform was employed to acquire the magnetic field signals of the BHTSM surface in real time during the pre-magnetization process and the re-magnetization process. Subsequently, three experimental aspects of levitation, including the vertical movement due to the levitation force, the lateral movement due to the guidance force, and the force relaxation with time, were explored above the PMG segment. Moreover, finite element modeling by COMSOL Multiphysics has been performed to simulate the different induced currents and the potentially different temperature rises with different modes inside the BHTSM. It was found that the S-S pole mode produced higher induced current density and a higher temperature rise inside the BHTSM, which might escalate its lateral instability above the PMG. The S-N pole mode exhibits the opposite characteristics. In general, this work is instructive for understanding and connecting the magnetic flux, the inner current density, the levitation behavior, and the temperature rise of BHTSMs employed in a maglev system

Рубрики: 29.19.29; 291.19.29.18.40.38.04

2017-02 FI17 БД ВИНИТИ

5 Yildizer Irfan, Cansiz Ahmet, Ozturk Kemal

Оптимизация сил левитации и наведения в сверхпроводящей системе магнитного подвеса. Optimization of levitation and guidance forces in a superconducting Maglev system. Cryogenics. 2016. 78, с. 57-65. Англ.

Optimization of the levitation for superconducting Maglev systems requires effective use of vertical and guidance forces during the operation. In this respect the levitation and guidance forces in terms of various permanent magnet array configurations are analyzed. The arrangements of permanent magnet arrays interacting with the superconductor are configured for the purpose of increasing the magnetic flux density. According to configurations, modeling the interaction forces between the permanent magnet and the superconductor are established in terms of the frozen image model. The model is complemented with the analytical calculations and provides a reasonable agreement with the experiments. The agreement of the analytical calculation associated with the frozen image model indicates a strong case to establish an optimization, in which provides preliminary analysis before constructing more complex Maglev system.

Рубрики: 29.19.29; 291.19.29.46.48.30

2017-04 FI17 БД ВИНИТИ

6 Wang Bo, Zheng Jun, Si Shuaishuai, Qian Nan, Li Haitao, Li Jipeng, Deng Zigang

Характеристики динамического отклика высокотемпературной сверхпроводящей системы магнитного подвеса при боковом нецентральном положении. Dynamic response characteristics of the high-temperature superconducting maglev system under lateral eccentric distance. Cryogenics. 2016. 77, с. 1-7. Англ.

Off-centre operation of high-temperature superconducting (HTS) maglev systems caused by inevitable conditions such as the misregistration of vehicle, crosswind and curve negotiation, may change the distribution of the trapped flux in the HTS bulks and the magnetic interaction between HTS bulks and the PMG. It impacts on the performance of HTS maglev, and more seriously makes the maglev vehicle overturned. Therefore, understanding the performance of the HTS maglev in off-center operation is very important. The dynamic response characteristics of a cryostat with twenty-four onboard YBaCuO superconductor bulks were experimentally investigated at different eccentric distances under loads before the initial FC process. Parameters such as vibration accelerations, displacement, natural frequency and dynamic stiffness were acquired and analyzed via the B&K vibration analyzer and laser displacement sensors. Results suggest that the natural frequency and dynamic stiffness of the maglev vehicle would be obviously reduced with the eccentric distance, posing negative effects on the stability of HTS maglev.

Рубрики: 29.19.29; 291.19.29.46.48.30

2017-05 FI17 БД ВИНИТИ

7 Li Y. J., Dai Q., Zhang Y., Wang H., Chen Z., Sun R. X., Zheng J., Deng C. Y., Deng Z. G.

Конструкция и анализ электромагнитного отворота для сверхпроводящей системы магнитного подвеса. Design and analysis of an electromagnetic turnout for the superconducting Maglev system. Physica. C. 2016. 528, с. 84-89. Англ.

Turnout is a crucial track junction device of the ground rail transportation system. For high temperature superconducting (HTS) Maglev system, the permanent magnet guideway (PMG) makes the strong magnetic

force existing between rail segments, which may cause moving difficulties and increase the operation cost when switching a PMG. A non-mechanical 'Y' shaped Halbach-type electromagnetic turnout was proposed. By replacing the PMs with electromagnets, the turnout can guide the maglev vehicle running into another PMG by simply controlling the current direction of electromagnets. The material and structure parameters of the electromagnets were optimized by simulation. The results show that the optimized electromagnet can keep the magnetic field above it as strong as the PMs', meanwhile feasible for design and manufacture. This work provides valuable references for the future design in non-mechanical PMG turnout.

Рубрики: 29.19.29; 291.19.29.46.48.30

2017-05 FI17 БД ВИНИТИ

8 Ye Chang-Qing, Ma Guang-Tong, Liu Kun, Wang Jia-Su

Наблюдение распределений поля, тока и сил в оптимизированной сверхпроводящей системе левитации с трансляционной симметрией. Observation of the field, current and force distributions in an optimized superconducting levitation with translational symmetry. J. Low Temp. Phys.. 2017. 186, N 1-2, с. 106-120. Библ. 26. Англ.

The superconducting levitation realized by immersing the high-temperature superconductors (HTSs) into nonuniform magnetic field is deemed promising in a wide range of industrial applications such as maglev transportation and kinetic energy storage. Using a well-established electromagnetic model to mathematically describe the HTS, the authors have developed an efficient scheme that is capable of intelligently and globally optimizing the permanent magnet guideway (PMG) with single or multiple HTSs levitated above for the maglev transportation applications. With maximizing the levitation force as the principal objective, they optimized the dimensional of a Halbachderived PMG to observe how the field, current and force distribute inside the HTSs when the optimized situation is achieved. Using a pristine PMG as a reference, they have analyzed the critical issues for enhancing the levitation force through comparing the field, current and force distributions between the optimized and pristine PMGs. It was also found that the optimized dimensions of the PMG are highly dependent upon the levitated HTS. Moreover, the guidance force is not always contradictory to the levitation force and may also be enhanced when the levitation force is prescribed to be the principle objective, depending on the configuration of levitation system and lateral displacement

Рубрики: 29.19.29; 291.19.29.18.40.38.04

2017-07 FI17 БД ВИНИТИ

9 Deng Zigang, Qian Nan, Che Tong, Jin Liwei, Si Shuaishuai, Zhang Ya, Zheng Jun

Подробное сравнение характеристик левитации объемных конструкций из YBaCuO над двумя различными типами магнитных направляющих. Comprehensive comparison of the levitation performance of bulk YBaCuO arrays above two different types of magnetic guideways. J. Magn. and Magn. Mater.. 2016. 420, с. 171-176. Англ.

The permanent magnet guideway (PMG) is an important part of high temperature superconducting (HTS) maglev systems. So far, two types of PMG, the normal PMG and Halbach-type PMG, are widely applied in present maglev transportation systems. In this paper, the levitation performance of high temperature superconductor bulks above the two PMGs was synthetically compared. Both static levitation performance and dynamic response characteristics were investigated. Benefiting from the reasonable magnetic field

distribution, the Halbach-type PMG is able to gain larger levitation force, greater levitation force decay during the same relaxation time, bigger resonance frequency and dynamic stiffness for the bulk superconductor levitation unit compared with the normal PMG. Another finding is that the Halbach-type PMG is not sensitive to the levitation performance of the bulk levitation unit with different arrays. These results are helpful for the practical application of HTS maglev systems.

Рубрики: 29.19.29; 291.19.29.46.48.30

2017-08 FI17 БД ВИНИТИ

10 Okubo T., Ueda N., Ohashi S.

Метод эффективного контроля системы активного гашения многонаправленных колебаний для сверхпроводящей магнитно-левитирующей каретки. Effective control method of the active damper system against the multidirectional vibration in the superconducting magnetically levitated bogie. IEEE Trans. Appl. Supercond.. 2016. 26, N 4. Англ.

Numerical analysis of the superconducting magnetically levitated bogie (JR Maglev) has been studied. In this system, electrodynamic suspension with the null-flux configuration is applied to keep the levitation and guidance position of the train without gap control. However, the damping factor of the system is little. The active damper coil is introduced to increase the damping factor. It has a large effect on reducing the vertical vibration. However, when the vertical vibration and pitching motion occur simultaneously, it does not control the vibration perfectly. The control method of the active damper coil is studied. The improved switching function (combined switching) that has an effect on the multidirectional vibration is modeled. Running simulation when the bogie passes the guideway displacement has been undertaken. The active damper that is controlled by the combined switching decreases the multidirectional vibration.

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2017-09 FI17 БД ВИНИТИ

11 Zheng B., Zheng J., Si S., Sun R., Qian N., Deng Z.

Признаки левитации объемов YBCO в условиях сверхохлаждения в среде низкого давления. Levitation performance of YBCO bulks in supercooling condition under a low-pressure environment. IEEE Trans. Appl. Supercond.. 2017. 27, N 4. Англ.

Taking the influence of low pressure on levitation performance of high temperature superconducting (HTS) maglev into account, the authors established a simple super-cooling platform based on pumping method to study the levitation performance of YBCO bulks above the Halbach permanent magnet guideway (PMG) under different pressure conditions. Through measuring the temperature of liquid nitrogen (LN2) during the decreasing process of pressure, it is known that the LN 2 would turn into a super-cooling state as the pressure reduction. Measurements of the levitation force versus vertical motion and the force relaxation were performed both in case of zero-field-cooling (ZFC) and field-cooling (FC). The experimental result showing that the decreasing pressure is beneficial to improve the levitation performance of HTS bulks, and the maximum force increase up to 23.5% and 22.1% were realized in ZFC and FC compared with the atmospheric pressure, respectively. Moreover, the low pressure could also reduce the hysteresis loop area and restrain the relaxation decay of levitation force. These results imply that, the low pressure environment in evacuated tube will be beneficial to the levitation performance of HTS maglev system.

Рубрики: 29.19.29; 291.19.29.18.40.38.04

2017-10 FI17 БД ВИНИТИ

12 Mizuno K., Sugino M., Tanaka M., Ogata M.

Экспериментальное изготовление магнита REBCO реального масштаба, рассчитанного на применение в системах магнитного подвеса. Experimental production of a real-scale REBCO magnet aimed at its application to maglev. IEEE Trans. Appl. Supercond.. 2017. 27, N 4. Англ.

The authors fabricated a REBCO magnet that demonstrates a magnetomotive force of 700 kA above 30 K. This magnet is comparable to the low temperature superconducting on-board magnet of the maglev with respect to coil size (racetrack-shaped, 1070 mm wide, 500 mm high) and magnetomotive force. The REBCO magnet does not have a radiation shield and is cooled by a single-stage Gifford-McMahon cryocooler. A 6-mm-wide coated conductor (SuperPower Inc. SCS6050-AP) is used for the coil winding. The number of turns and the wire length are 2800 and approximately 7600 m, respectively. In this coil fabrication, the authors utilized thermoplastic resin instead of epoxy impregnation. The REBCO magnet was excited at 35 K, and a magnetomotive force of 700 kA was successfully achieved. In addition, a magnetomotive force of 750 kA was also achieved at 32 K.

Рубрики: 29.19.29; 291.19.29.18.40.38.04

2017-10 FI17 БД ВИНИТИ

13 Qian N., Zheng J., Lei W., Wang B., Li J., Ren Y., Deng Z.

Характеристики динамических колебаний ВТСП систем левитации, работающих на направляющих линиях проверки постоянного магнита. Dynamic vibration characteristics of HTS levitation systems operating on a permanent magnet guideway test line. IEEE Trans. Appl. Supercond.. 2017. 27, N 4. Англ.

With the development of high temperature superconducting (HTS) maglev stepping in a key period of test line applications, the test and analysis of the dynamic operation parameters become more and more crucial. In this paper, the dynamic operating characteristics of single-cryostat and multicryostat levitation systems were comparatively studied on a 45-m-long permanent magnet guideway test line with different working conditions. Vibration acceleration signals of three levitation systems (a single cryostat, a bogie with two cryostats, and a car with four cryostats) were measured in the running experiments. The vibration characteristics were analyzed in both time domain and frequency domain. Results show that the multicryostat levitation system has better dynamic performance of stiffness than those of the single-cryostat system. The experimental data also indicates a positive correlation between the stability of the HTS maglev vehicle and the number of the cryostat. This work is helpful to understand the essential characteristics of HTS maglev vehicle system, and will be beneficial to the future design.

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2017-10 FI17 БД ВИНИТИ

14 Chung Y. D., Lee C. Y., Kim D. W., Kang H., Park Y. G., Yoon Y. S.

Концептуальная конструкция и рабочие характеристики многорезонансных антенн в беспроводной системе потребления электроэнергии поезда на сверхпроводящей магнитной подвеске. Conceptual design and operating characteristics of multi-resonance antennas in the wireless power charging system for superconducting MAGLEV train. IEEE Trans. Appl. Supercond.. 2017. 27, N 4. Англ.

Recently super high-speed magnetic levitation (MAGLEV) using high-temperature superconducting (HTS) magnet has been expected as next-generation transportation since superconducting magnet can keep mighty levitation force. The superconducting magnet at MAGLEV train should be continually charged with high power in order to keep stronger and stable levitation force. Practically, since conventional power supply unit should be attached to HTS magnet in the MAGLEV, a large thermal loss is indispensably caused by power transfer wires and joints, those have been one of essential obstacles in the superconducting MAGLEV train. As the wireless power transfer (WPT) technology based on strongly resonance-coupled method realizes large power charging without any wires through the air, there are advantages compared with the wired counterparts, such as convenient, safety, and fearless transmission of power. From this reason, the WPT systems have started to be applied to the wireless charging for various power applications, such as transportations (train, underwater ship, electric vehicle). However, it has obstacles to commercialize, such as delivery distance and efficiency. To solve the problems, authors proposed the technical fusion using HTS resonance coil in the WPT system since the superconducting wire has merits a larger current density and higher Q -value than normal conducting wire. In this study, authors described the conceptual design of HTS receiver (Rx) coil with multi-copper antenna (Tx) coils. The priority characteristics of moving HTS receivers under multi-copper Tx coils are compared with and various copper Rx coils with radio frequency power of 370 kHz below 300 W.

Рубрики: 29.19.29; 291.19.29.18.40.38.04

2017-10 FI17 БД ВИНИТИ

15 Werfel F. N., Floegel-Delor U., Rothfeld R., Riedel T., Schirrmeister P., Koenig R., Kantarbar V.

Влияние низких температур и сверхпроводящих компонент для ВТСП приборов магнитной левитации. Impact of cryogenics and superconducting components for HTS magnetic levitation devices. IEEE Trans. Appl. Supercond.. 2017. 27, N 4. Англ.

Practical REBCO bulk superconductor-based components and devices as rotational and linear magnetic bearings are well understood. A high-stiffness high temperature superconductor (HTS) magnetic bearing with 0.1 mm low-hysteresis is demonstrated for narrow-gap operation. Linear magnetic bearings up to 10-ton load have been successfully implemented in linear Maglev trains under real outside conditions. The REBCO bulk-based magnetic levitated (Maglev) trains are proposed for urban and low-speed transport concepts. On the contrary, high-mobile, lightweight, and flexible HTS bulk components are developed under the extreme and safe conditions of manned spaceflight for astronomy and space application. YBCO bulk proton irradiation tests for space application are presented. In the International Space Station (ISS), the interaction of the earth magnetic field with a perfect fast-moving diamagnet within a project called Magvector/MFX is measured and investigated. The authors compare an anticipated model with space experiments performed in the last two years in the ISS. The paper will summarize recent progress in this field, and present how cryogenic and HTS component design can positively impact levitation and screening performance. Properties of cryogenic systems and devices of mobile applications in their complexity and required robustness will be compared to stationary HTS systems, and the effect of different cooling options has to been considered.

Рубрики: 29.19.29; 291.19.29.22.16.04

2017-10 FI17 БД ВИНИТИ

16 Huang Huan, Zheng Jun, Qian Nan, Che Tong, Zheng Botian, Jin Liwei, Deng Zigang

Магнитные сигналы от объемного высокотемпературного сверхпроводника в течение процесса измерения левитационной силы. Magnetic signals of high-temperature superconductor bulk during the levitation force measurement process. J. Low Temp. Phys.. 2017. 187, N 3-4, с. 287-297. Библ. 16. Англ.

In order to study the commonly neglected magnetic field information in the course of levitation force measurement process in a superconducting maglev system, a multipoint magnetic field measurement platform was employed to acquire magnetic signals of a bulk high-Tc superconductor on both the top and the bottom surface. Working conditions including field cooling (FC) and zero field cooling were investigated for these vertical down and up motions above a permanent magnet guideway performed on a HTS maglev measurement system. The authors have discussed the magnetic flux variation process based on the Bean model. A magnetic hysteresis effect similar to the levitation force hysteresis loop of the bulk superconductor was displayed and analyzed in this paper. What is more valuable, there exists some available magnetic flux on the top surface of the bulk superconductor, and the proportion is as high as 62.42% in the FC condition, which provides an experimental hint to design the superconductor bulk and the applied field for practical use in a more efficient way. In particular, this work reveals real-time magnetic flux variation of the bulk superconductor in the levitation application, which is the other important information in contrast to the macroscopic levitation and guidance force investigations in previous studies, and it enriches the existing research methods. The results are significant for understanding the magnetic characteristic of superconductors, and they can contribute to optimize the present HTS maglev system design

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2017-10 FI17 БД ВИНИТИ

17 Qiu D., Wu W., Pan Y., Xu S., Zhang Z. M., Li Z. L., Li Z. Y., Wang Y., Wang L., Zhao Y., Zhang Z. W., Yang P., Hong Z., Jin Z.

Экспериментальный и численный анализ стабильности магнитного поля катушки постоянного тока, изготовленной из ВТСП проводников в оболочке. Experiment and numerical analysis on magnetic field stability of persistent current mode coil made of HTS-coated conductors. IEEE Trans. Appl. Supercond.. 2017. 27, N 4. Англ.

High-temperature superconducting (HTS) coils made of coated conductors that can operate in persistent current mode (PCM) are regarded to be promising in MRI/nuclear magnetic resonance and Maglev system. The temporal stability of the magnetic field trapped by the PCM coil is a key issue, which significantly determines the imaging quality of MRI and dynamic behavior of Maglev. This study focuses on the temporal stability of the trapped magnetic field in the double-slit HTS PCM coil, which is magnetized by a field cooling (FC) method at 77 K. The magnetic field decay behavior under different initial fields and FC ramp rates are systematically studied. The experiment results indicate that higher initially trapped field will lead to faster decay, but if the initially trapped field is lower than a certain value, this trend is no longer obvious. The FC ramp rate has a little impact on the field decay. Finally, a numerical model based on R-L circuit and E-J equation is established to fit the decay process. It is found that if the operating current is lower than 60% of the coil critical current, good temporal stability could be achieved. Another long-term experiment is performed that a stability of 8.1 ppm/h is achieved after 19 days' decay.

Рубрики: 29.19.29; 291.19.29.46.48.04.26

2017-11 FI17 БД ВИНИТИ

18 Lei Wuyang, Qian Nan, Zheng Jun, Huang Huan, Zhang Ya, Deng Zigang

Конструкция магнитного профилирования для направляющей постоянного магнита Халбаха для высокотемпературной сверхпроводящей системы магнитного подвеса. Magnetic superelevation design of Halbach permanent magnet guideway for high-temperature superconducting maglev. Physica. C. 2017. 538, с. 1-5. Англ.

To improve the curve negotiating ability of high-temperature superconducting (HTS) maglev system, a special structure of magnetic superelevation for double-pole Halbach permanent magnet guideway (PMG) was designed. The most significant feature of this design is the asymmetrical PMG that forms a slanting magnetic field without affecting the smoothness of the PMG surface. When HTS maglev vehicle runs through curves with magnetic superelevation, the vehicle will slant due to asymmetry in magnetic field and the flux-pinning effect of onboard HTS bulks. At the same time, one component of the levitation force provides a part of the centripetal force that reduces lateral acceleration of the vehicle and thus enhances its curve negotiating ability. Furthermore, the slant angle of magnetic superelevation can be adjusted by changing the materials and the thickness of the added permanent magnets. This magnetic superelevation method, together with orographic uplift, can be applied to different requirements of PMG designs. Besides, the applicability of this method would benefit future development of high-speed HTS maglev system.

Рубрики: 29.19.29; 291.19.29.46.48.30

2017-12 FI17 БД ВИНИТИ

19 Jin L., Zheng J., Li H., Li J., Zhou Z., Zhang Y., Deng Z.

Влияние демпфера вихревых токов на динамические колебательные характеристики высокотемпературной сверхпроводящей системы магнитного подвеса. Effect of eddy current damper on the dynamic vibration characteristics of high-temperature superconducting maglev system. IEEE Trans. Appl. Supercond.. 2017. 27, N 3. Англ.

The high-temperature superconducting (HTS) magnetic levitation (maglev) has demonstrated many advantages such as self-levitation, self-guidance, environment friendliness by using liquid nitrogen, and low noise. But it has a weakness of low damping, which is not beneficial for the systemic stability and security when the maglev vehicle is disturbed by external environment such as crosswind and track irregularity. To enhance the dynamic stability of the HTS maglev system, a simple and effective approach by inserting eddy current damper (ECD) into the bottom of HTS bulks has been considered. In this paper, the authors investigated the dynamic effect of ECD on the vibration amplitude and frequency of the HTS maglev system by introducing different thicknesses copper damper underneath the HTS bulks with different velocities by measuring the displacement and acceleration signals of an HTS levitator. In theory, the authors analyzed the effect of ECD on the dynamic stiffness. Experimental results manifest that the additional copper damper can effectively reduce the vibration amplitude of the HTS levitator, meanwhile it has little influence on the vibration frequency. The ECD has little effect on dynamic stiffness by theoretical analysis. An optimum thickness of copper damper to reduce the dynamic vibration is proposed for the HTS maglev system.

Рубрики: 29.19.29; 291.19.29.46.48.30

2017-12 FI17 БД ВИНИТИ

20 Zhou D., Cui C., Zhao L., Zhang Y., Wang X., Zhao Y.

Устойчивость движения прототипа транспортного средства в системе опытного кольца с ВТСП магнитным подвесом. Running stability of a prototype vehicle in a side-suspended HTS maglev circular test track system. IEEE Trans. Appl. Supercond.. 2017. 27, N 1. Англ.

To improve the running speed of the high-Tc superconductor (HTS) maglev system, a circular test track system with the maglev vehicle suspending beside the permanent magnetic guideway (PMG) is studied. A test to determine the change in guidance force when a YBa2Cu3O7 (YBCO) bulk gets close to and off the center of the PMG is carried out and the curve of relation between levitation gap and vertical eccentric displacement of the YBCO bulk under constant guidance force is obtained. The results show that eccentric motion in the vertical direction may occur during free side-suspended operation of the maglev vehicle in the circular track, which leads to a reduction in levitation gap and an increase in vertical eccentric displacement, decaying and enhancing the guidance force, respectively. Eccentric motion can be effectively restrained by reducing the field cooling height and the weight of the maglev vehicle to improve the running stability of the maglev vehicle. Finally, a circular test track 6.5 m in diameter and 20.4 m in length and a prototype vehicle are designed and constructed on the basis of the side-suspended HTS maglev system.

Рубрики: 29.19.29; 291.19.29.46.48.30

2017-12 FI17 БД ВИНИТИ

21 Козлова Н. Н., Марюхненко В. С.

Перспективы развития в России поезда на магнитном подвесе. Современные проблемы радиоэлектроники и связи: Материалы 14 Всероссийской научно-технической конференции студентов, аспирантов и молодых ученых, Иркутск, 19 мая, 2016. Иркутск. 2016, с. 42-48. Рус.

В работе проведено исследование существующих технологий реализации поездов системы maglev и их основных недостатков, исследование возможностей внедрения в эксплуатацию в нынешних условиях и рассмотрение влияния данной транспортной системы на окружающую среду и здоровье человека.

Рубрики: 55.41.39; 551.41.39.29

2017-08 MH28 БД ВИНИТИ

22 Wai Rong-Jong, Chen Meng-Wei, Yao Jing-Xiang

Адаптивный обсервер для транспортной системы на магнитном подвесе. Observer-based adaptive fuzzy-neural-network control for hybrid maglev transportation system. Neurocomputing. 2016. 175, с. 10-24. Англ.

Разработана динамическая модель транспортной системы на магнитном подвесе (maglev), включая гибридные электромагниты и тяговый линейный мотор. Для контроля скорости предложен адаптивный обсервер на базе нейронной сети с нечеткой логикой

Рубрики: 73.29.01; 733.29.01.21.17

2017-01 TR21 БД ВИНИТИ

23 Yang Ping, Liu De-jun, Li Xiao-zhen

Динамическая реакция направляющей балки транспортной системы Maglev. Investigation of dynamic factors of low and medium speed maglev simply-supported guideway beam. Qiaoliang jianshe=Bridge Constr.. 2016. 46, N 4, с. 79-84. Библ. 10. Кит.; рез. англ.

Для изучения динамическрой реакции просто опертой направляющей балки при воздействии нагрузок от поездов, едущих с малой и средней скоростью в системе Maglev, построена расчетная модель вертикальной совместной вибрации поезда и этой балки с учетом электромагнитной теории и контрольных принципов PD обратной связи контролируемого левитатора (levitator). С помощью этой модели определено влияние скорости и массы поезда и степени демпфирования моста на динамические факторы просто опертой направляющей балки пролетом 20 м., которые сравнивались с данными полевых замеров.

Рубрики: 73.43.31; 733.43.31.21

2017-05 TR06 БД ВИНИТИ

24 Ким К. К.

Вариант вакуумной транспортной системы. Ж.-д. трансп.. 2016, N 12, с. 66-68. Рус.

Изложены технические вопросы создания и работоспособности системы вакуумного транспорта (создание технического вакуума, конструкция капсулы и пр. - предложен вариант с размещением статора снаружи стенки трубы) в сравнении с магнитным подвесом, рассмотрена целесообразность создания и эксплуатации такой системы. Опубликованы выдержки из докладов аспирантов и сотрудников ПГУПС на 23-й Международной конференции Maglev 2016, дающие представление о направлении исследований молодых научных работников в области высокоскоростного наземного транспорта. Это использование магнитолевитационной технологии для скоростных грузовых магистральных линий; создание автономной компьютерной интеллектуальной системы, способной выполнять функции механического запорного пломбировочного устройства (ИЭЗПУ); применение сверхпроводниковых материалов в магнитолевитационных системах.

Рубрики: 73.49.31; 733.49.31

2017-06 TR07 БД ВИНИТИ

25 Han Xiahui, Li Jianlang

Лазер на вращающемся диске, подвешенном в магнитном поле. Maglev rotating disk laser. Chinese Optics Letters. 2015. 13, N 12, с. 121403/1-121403/4. Библ. 13. Англ.

Приведены результаты первоначальных исследований лазера на дисковой активной среде, подвешенной в магнитном поле. Тонкий диск из Nd:YAG кристалла, используемого в качестве активной среды, соединен с круглой пластиной из пиролитического графита, подвешенной в над постоянным магнитом. Так как такой диск слишком тяжел для введения его во вращение вращательной кинетической энергией непоглощенной мощности накачки, вращательная кинетическая энергия активируется потоком сжатого азота из двух сопел для обеспечения вращения подвешенного диска. В таком вращающемся дисковом лазере исключаются вредные тепловые эффекты, такие как наведенное теплом двулучеапреломление, тепловые напряжения и формирование тепловой линзы.

Экспериментально получена одномодовая генерация с выходной мощностью 17.7 мВт при поглощенной мощности накачки 447 мВт при частоте вращения лазерного диска 4 Гц.

Рубрики: 47.35.31; 474.35.31.09

2016-08 АВ16 БД ВИНИТИ

26 Liu S.-K., An B., Liu S.-K., Guo Z.-J.

Исследование характеристик электромагнитной силы комбинированной подвески в низкоскоростном магнитоплане. Characteristic research of electromagnetic force for mixing suspension electromagnet used in low-speed maglev train. IET Elec. Power Appl.. 2015. 9, N 3, с. 223-228. Англ.

Качество электромагнитной подвески существенно влияет на технико-экономические показатели и безопасность магнитоплана в целом. Описана новая структура электромагнита подвески, включающая постоянные магниты и электромагнитные катушки. Осуществлен анализ характеристик гибридного электромагнита на основе двух- и трехмерного конечно-элементного подхода. Проведено моделирование для четырех типовых режимов эксплуатации магнитоплана: полная загрузка с фиксированным зазором 8 мм; полная загрузка с начальным зазором 18 мм; полная загрузка с зазором 10 мм; порожняк с зазором 3 мм и предохранением от касания магнитов поверхности движения. Исследовано влияние величины зазора и тока катушки на электромагнитную силу. Расчеты и эксперименты подтвердили реализуемость гибридной электромагнитной подвески и ее энергоэффективность

Рубрики: 45.53.37; 451.53.37.29.35.31

2016-07 EL08 БД ВИНИТИ

27 He Dabo, Zheng Jun, Zheng Botian, Sun Ruixue, Che Tong, Gou Yanfeng, Deng Zigang

Пространственные и временные свойства захваченного потока в объемных высокотемпературных сверхпроводниках в полях статической намагниченности. Spatial and temporal flux-trapping properties of bulk high temperature superconductors under static magnetization fields. J. Supercond. and Novel Magn.. 2015. 28, N 8, с. 2385-2391. Англ.

Magnetized YBaCuO bulks are available to enhance the levitation performance of present superconducting maglev systems due to their high trapped fields. To realize a good YBaCuO bulk magnet, we studied the flux-trapping properties of an YBaCuO bulk sample under different magnetization fields from two aspects. Firstly in spatial view, five Hall sensors were employed to measure the trapped magnetic fields at five typical positions of growth sector regions and growth sector boundaries on the seeded surface of the bulk. And then in temporal view, the trapped magnetic fields of these five positions were continually recorded by a real-time data acquisition device during the magnetization process and the succeeding relaxation processes. Results show that the saturated trapped fields at five surface positions of the YBaCuO bulk magnet exhibit the strong spatial inhomogeneity. The trapped fields at the growth sector boundaries are always higher than those at the growth sector regions, due to different critical current density distributions of the bulk superconductor. And the magnetization field required to saturate the center of the bulk is much higher than that of the edge region. But the much high magnetization field will reduce the final trapped field at the edge of the bulk. Moreover the trapped field variation with time is sensitive to the participation of some external ferromagnetism materials. It

is found that the adding of an iron plate above the YBaCuO bulk surface is efficacious to restrain the trapped field relaxation.

Рубрики: 29.19.29; 291.19.29.22.16.06

2016-02 FI17 БД ВИНИТИ

28 Ozturk K., Abdioglu M., Sahin E., Celik S., Gedikli H., Savaskan B.

Влияние распределения магнитного поля и полюсов на свойства вертикальной силы левитации ВТСП системы магнитного подвеса. The effect of magnetic field distribution and pole array on the vertical levitation force properties of HTS Maglev systems. IEEE Trans. Appl. Supercond.. 2015. 25, N 4, с. 3601607. Англ.

The levitation force measurements have been carried out by the magnetic force measurement system under both field-cooling and zero-field-cooling regimes, whereas the magnetic field distribution over the permanent-magnet guideway (PMG) was calculated by numerical analysis based on the finite-element method. It was shown in this study that the vertical levitation capability and stability of Maglev systems can be improved depending on the cooling regime, pole number, and suitable arrangement of the PMG. It was shown that when the pole number increases, the levitation force density increases. It also appeared that the reasonable position of the supplementary permanent magnet and appropriate cooling heights are key parameters for both levitation performance and stabilization of the high-temperature superconductor (HTS) Maglev. It is believed that the numerical and experimental data in this paper are useful for relative design and practical application of HTS Maglev systems

Рубрики: 29.19.29; 291.19.29.46.48.30

2016-03 FI17 БД ВИНИТИ

29 Liang G., Zhao L., Yang J., Ma J., Zhang Y., Wang X., Zhao Y.

Изучение характеристик вращающейся системы магнитного подвеса на основе высокотемпературного сверхпроводника с боковым креплением. Study of the maglev performance of the side-mounted high-temperature superconductor maglev rotating system. IEEE Trans. Appl. Supercond.. 2015. 25, N 4, с. 3601406. Англ.

A new type of maglev system, a side-mounted high-temperature superconductor (HTS) maglev system, designed to run at high speed in an evacuated circular tube is presented. The levitation performance of the system was investigated. Results show that the stability of the maglev system is strongly dependent on the arrangements of HTS bulks along the center of permanent-magnet guideway. For the linear arrangement, the guidance force tends to drive HTS bulks away from the magnetic hill with the decrease of suspending gap. This may cause the levitation force decrease at the same time. In the comparison with the quadrilateral, square and liner arrangement of the HTS bulks, the triangular arrangement possesses the best maglev performance

Рубрики: 29.19.29; 291.19.29.46.48.30

2016-03 FI17 БД ВИНИТИ

30 Yang P.-T., Yang W.-M., Wang M., Li J.-W., Guo Y.-X.

Эффективный метод контроля силы левитации и высота левитации в сверхпроводящих системах магнитного подвеса. Effective method to control the levitation force and levitation height in a superconducting maglev system. Chin. Phys. B. 2015. 24, N 11, с. 117403. Англ.

The influence of the width of the middle magnet in the permanent magnet guideways (PMGs) on the levitation force and the levitation height of single-domain yttrium barium copper oxide (YBCO) bulks has been investigated at 77 K under the zero field cooled state. It is found that the largest levitation force can be obtained in the system with the width of the middle magnet of the PMG equal to the size of the YBCO bulk when gap between the YBCO bulk and PMG is small. Both larger levitation force and higher levitation height can be obtained in the system with the width of the middle magnet of the PMG larger than the size of the YBCO bulk. The stiffness of the levitation force between the PMG and the YBCO bulk is higher in the system with a smaller width of the middle magnet in the PMG. These results provide an effective way to control the levitation force and the levitation height for the superconducting maglev design and applications

Рубрики: 29.19.29; 291.19.29.46.48.30

2016-03 FI17 БД ВИНИТИ

31 Jiang Zhao-Fei, Gou Xiao-Fan

Влияние вихревого затухания от добавочных проводников в сверхпроводящих системах левитации. Eddy damping effect of additional conductors in superconducting levitation systems. Physica. C. 2015. 519, с. 112-117. Англ.

Passive superconducting levitation systems consisting of a high temperature superconductor (HTSC) and a permanent magnet (PM) have demonstrated several fascinating applications such as the maglev system, flywheel energy storage. Generally, for the HTSC-PM levitation system, the HTSC with higher critical current density Jc can obtain larger magnetic force to make the PM levitate over the HTSC (or suspended below the HTSC), however, the process of the vibration of the levitated PM, provides very limited inherent damping (essentially hysteresis). To improve the dynamic stability of the levitated PM, eddy damping of additional conductors can be considered as the most simple and effective approach. In this article, for the HTSC-PM levitation system with an additional copper damper attached to the HTSC, the authors numerically and comprehensively investigated the damping coefficient c, damping ratio, Joule heating of the copper damper, and the vibration frequency of the PM as well. Furthermore, the authors comparatively studied four different arrangements of the copper damper, on the comprehensive analyzed the damping effect, efficiency (defined by c/VCu, in which VCu is the volume of the damper) and Joule heating, and finally presented the most advisable arrangement.

Рубрики: 29.19.29; 291.19.29.18.40.38.04

2016-11 FI17 БД ВИНИТИ

32 Qian Nan, Zheng Botian, Gou Yanfeng, Chen Ping, Zheng Jun, Deng Zigang

Изучение влияния кривой сопряжения на динамические характеристики высокотемпературного сверхпроводящего магнитного подвеса. Study on the effect of transition curve to the dynamic characteristics of high-temperature superconducting maglev. Physica. C. 2015. 519, с. 34-42. Англ.

High temperature superconducting (HTS) maglev technology is becoming more and more mature, and many key technologies have been deeply studied. However, the transition curve plays a key role in HTS maglev system, and related studies have not been carried out. In this paper series of simulations were conducted to test the lateral and vertical vibration of HTS maglev when passing through curves. Two magnetic guideways, of which one has transition curves but the other does not, are designed to test the vibration characteristics of a mini HTS maglev model running though curves. Results show that after adding transition curves between straight line and circular curve the vibration of HTS maglev model in lateral and vertical directions are all weakened in different degrees. It proves that adding transition curve into HTS maglev system is favorable and necessary.

Рубрики: 29.19.29; 291.19.29.46.48.30

2016-11 FI17 БД ВИНИТИ