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“润滑密封与耐磨材料”专刊序言

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随着工业化进程的不断推进, 机械设备在现代社会中的广泛应用和日益复杂的工作环境要求我们不断优化和创新关键部件的设计和材料性能. 润滑、密封与耐磨材料作为解决摩擦、磨损及腐蚀等问题的核心技术, 已成为工程领域中的重要研究方向. 在这一背景下, 润滑、密封与耐磨材料的研究不仅关系到提高机械设备的工作效率和延长使用寿命, 而且对节能降耗、减少环境污染以及保障设备安全运行具有重要意义. 近年来, 在国家重大科技专项和工程化需求的驱动下, 国内外学者围绕润滑密封与耐磨材料领域的核心科学问题和工程挑战, 开展了大量研究并取得了显著进展.

未来, 润滑密封与耐磨材料将在先进装备中承担更加重要的角色, 其发展方向将朝向智能化、自适应和多功能集成化迈进. 在润滑材料方面, 润滑剂材料研制和改性是1项重要的研究工作, 除此之外, 润滑理论一直支撑着摩擦学学科中应用数学方面的理论构建. 从润滑状态的形成、转变和恶劣机理, 到润滑模型的构建和数值计算, 基本形成了机械摩擦副润滑设计方法. 随着理论研究的深入和试验技术的发展, 润滑研究发展趋势正由宏观进入微观, 由定性到定量, 由稳态到瞬态, 特别在空间润滑、轻量化转子轴承润滑、食品装备润滑、高端轴承和齿轮润滑以及船舶水润滑等方面取得了重要成果. 在密封材料方面, 密封技术则通过有效隔离内部介质与外部环境, 防止泄漏和污染, 为设备的长期稳定运行提供了保障. 随着密封材料和结构设计的不断创新, 密封技术在提高机械密封性能、减少维护成本以及延长设备使用寿命方面发挥了越来越重要的作用. 在耐磨材料方面, 耐磨材料与减摩技术是现代工业装备的关键技术支撑, 直接关系到机械系统的运行效率、可靠性和寿命. 耐磨材料通过在极端环境下提供卓越的抗磨损能力, 为机械系统的稳定运行提供了有力支撑. 而减摩技术通过摩擦副的成分设计优化与微观结构调控等手段, 实现摩擦和磨损的显著降低. 两者的协同发展在高速、高温、高压及腐蚀性环境等复杂工况中尤为重要.

《摩擦学学报(中英文)》推出了“润滑密封及耐磨材料”专刊, 旨在反映近期我国高校、科研院所以及企业在润滑密封及耐磨材料领域的最新研究进展. 专刊内包含13篇最新研究论文和1篇评述与进展论文. 本专刊收集了国内高水平研究团队在润滑密封及耐磨材料方面的研究成果, 包括润滑机理、建模分析、磨损机制、新材料制备、材料改性以及摩擦学试验等, 希望通过这期专刊论文的整理和发表, 能够吸引更多的专家学者致力于润滑密封与耐磨材料技术的研究, 促进我国摩擦学事业的蓬勃发展.

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Preface to Special Issue “Lubrication, Sealing and Wear-Resistant Materials”

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With the continuous advancement of industrialization, the wide application of machinery in modern society and the increasingly complex working environment require us to continuously optimize and innovate the design and material properties of key components. Lubrication, sealing and wear resistant materials, as the core technologies to solve the problems of friction, wear and corrosion, have become an important research direction in the field of engineering. In this context, the research of lubrication, sealing and wear-resistant materials is not only related to improving the work efficiency and extending the service life of mechanical equipment, but also has great significance for energy saving, reducing environmental pollution and ensuring the safe operation of equipment. In recent years, driven by major national science and technology projects and engineering needs, scholars domestic and overseas have carried out a lot of researches and made remarkable progress around the core scientific problems and engineering challenges in the field of lubricating, sealing and wear-resistant materials.

In the future, lubricating, sealing and wear-resistant materials will play a more important role in advanced equipment, and its development direction will be toward intelligent, adaptive and multi-functional integration. In terms of lubrication materials, the development and modification of lubricant materials is an important research work. In addition, lubrication theory has always supported the theoretical construction of applied mathematics in tribology. From the formation, transformation and scurviness mechanism of lubrication state to the construction of lubrication model and numerical calculation, the lubrication design method of mechanical friction pair is basically formed. In terms of sealing materials, the sealing technology effectively isolates the internal media from the external environment, preventing leakage and pollution, and providing a guarantee for the long-term stable operation of the equipment. In terms of wear-resistant materials, wear-resistant materials and anti-friction technology are the key technical support of modern industrial equipment, which is directly related to the operating efficiency, reliability and life of mechanical systems. The anti-friction technology can reduce friction and wear significantly by means of composition design optimization and microstructure control of friction pairs.

Tribology has launched a special issue of “Lubrication, Sealing and Wear-Resistant Materials” to reflect the latest research progress in the field of lubrication seals and wear-resistant materials in China’s universities, research institutes and enterprises. The special issue contains 13 latest research papers and 1 review paper. This special issue collects the research results of domestic high-level research teams on lubrication seals and wear-resistant materials, including lubrication mechanism, modeling analysis, wear mechanism, new material preparation, material modification and tribological tests, etc. It is hoped that through the collation and publication of papers in this special issue, more experts and scholars can be attracted to devote themselves to the research of lubrication, sealing and wear-resistant materials technology, so promoting the vigorous development of Chinese tribology.

On the occasion of the publication of this special issue, I would like to express my sincere thanks to Wuhan University of Technology, East China Jiaotong University, Chongqing University of Technology, Nanjing University of Aeronautics and Astronautics, Central South University and Jiangsu Ocean University for their support. Here, I would like to thank all the authors who contributed to this issue and the peer experts and reviewers who supported the publication of this issue.