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Editorial

Micro-Powers Scientific Research: Opening a New Chapter

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Recently, there have been several scientific breakthroughs in the fields of micro- and nanoscience. The *Micro* journal is a distinguished international open-access journal that is known for sharing the latest research advances in physics, chemistry, materials, biology, medicine and engineering. This editorial describes the vision and mission of the *Micro* journal while also providing a glimpse into the promising future of micro- and nanoscience. Within this field, areas of intense research activity include biomedical research, energy and environmental studies, electronic devices, industrial applications and microfluidic technologies.

In the field of biomedicine, a series of innovations are pushing the technological frontier. In 2023, Wu's team optimized ACET-enhanced biosensors to significantly enhance their detection speed and sensitivity, providing a new method for rapid disease diagnosis [1]. In 2024, Zhang's team developed a biosensor based on DNA and optical fiber technology that uses gold nanoparticles for signal enhancement. This biosensor achieved the highly selective and rapid detection of iodide, providing a new method for clinical diagnosis [2]. Kucukturkmen et al. used microfluidic technology to accurately synthesize nanoparticles, improving the effectiveness and repeatability of drug delivery systems [3]. In 2022, Santino's team developed nanoparticles that offer a less toxic option for cancer diagnosis and treatment [4]. In addition, Zhitomirsky et al. developed novel composite membranes that incorporate the biocompatibility of diamond, along with its other excellent properties, avoiding the use of traditional toxic solvents [5]. In 2024, Jia's team prepared a TiZrHfNbTa nanomembrane through annealing on stainless steel with good hardness and wear resistance, as well as excellent corrosion resistance. This membrane is able promote osteoblast proliferation and matrix mineralization and therefore could be applied as a high-entropy alloy coating in bone implants [6]. Li's team studied an enhanced implantable biodegradable TENG based on a PVA aerogel for the real-time monitoring of muscle activity [7]. Together, these research results not only promote the progress of biomedical technology but also show promising potential for future disease treatment and diagnosis.

In the fields of environmental science and energy, researchers have focused on CO_2 disposal and marine pollution. To harvest energy from seawater, a super-hydrophobic surface is created from laser-treated silicone rubber. Mahajan's team provided a new method of reducing CO_2 emissions by developing Si-Fe nanostructured materials [8]. In 2024, Wen et al. successfully synthesized a multifunctional ionic covalent triazine skeleton catalyst for the CO_2 cycloaddition reaction, which maintained high catalytic activity at diluted CO_2 concentrations and in mild conditions [9]. Song's team studied and synthesized nitrogen-doped reduced graphene oxide, providing a simple and reproducible method for wastewater treatment [10]. Fonseca et al. revealed the impact of biofilms on the distribution of microplastic particles in the ocean, providing a new perspective on decontamination strategies [11].

In the field of new energy, the development of new super-combustible propellants using biomass waste has promoted the use of sustainable energy. In 2022, Enthilkumar's

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team used graphite particles (GPs) and carbon cloth (CC) as MFC anode electrodes, showing that GP electrodes can be used for efficient wastewater treatment and power generation in MFC [12]. In 2023, Robbins found that bacteria growing in Cu-OH-Cl mineral membranes on the surface of saltwater ponds may use petroleum as a carbon source, providing possibilities for environmental remediation [13].

In the industrial sector, technological advances have had a significant impact on food packaging, functional textiles and coatings. Hou et al. developed highly thermal textile gloves with improved heat dissipation from carbon nanotubes [14]. In 2022, Zhou's team demonstrated a continuous and controllable method to prepare ultra-dense MXene fibers with good strength, toughness and electrical conductivity characteristics through the synergistic effect of interface interactions and thermal tensile stress [15]. Loupassaki encapsulated clove essential oil in hydroxypropyl-β-cyclodextrin to create smart food packaging material with a controlled release function, enhancing food preservation [16]. Annur et al. successfully developed a PH-sensitive indicator film using rhizome starch/carrageenan and different concentrations of grape skin extract as raw materials. The resulting film was low-cost and had good thermal stability [17]. Meucci's team optimized low-voltage wire and cable composites based on natural magnesium hydroxide to improve their mechanical properties and flame retardancy [18]. Suo's team made a hydrogen gel coating with low friction and good stability. This gel can be widely used in many fields, such as for stimulus response and antifouling models [19]. Together, these results have furthered the development of this industry and offered new methods for enhancing product performance and environmental protection.

In the field of electronic devices, much progress has been made in research on semiconductor materials. In 2022, Roccaforte et al. achieved the precise doping of SiC and GaN through ion implantation technology, improving the performance of power devices [20]. Zabotnov et al. used femtosecond laser technology to create micro/nanostructures on $Ge_2Sb_2Te_5$ films with the potential to enhance storage technologies [21]. Schwenk et al. used copper and silver iodide wire to make humidity sensors with high monitoring sensitivity [22]. Devesa et al. prepared α-$BiNbO_4$ and β-$BiNbO_4$ ceramics through wet chemistry, offering insights into the properties of new semiconductor materials [23]. Elif's team studied the temperature-dependent electronic band structure of β-Ga_2O_3 in the range of 0 to 900 K using first-principles simulations combined with optical measurement techniques. At the same time, they evaluated the band edge displacement caused by temperature [24]. Kim et al. created high-efficiency and uniform perovskite LEDs (PeLEDs) with a large area by utilizing pre-crystallized colloidal perovskite nanocrystals and an enhanced rod-coating technique [25]. These achievements not only further the performance of electronic devices but also offer new research directions for semiconductor applications.

In the field of microfluidic technology, Senf et al. studied the particle trajectories of airfoil DLD microfluidic separation technology while varying the Reynolds number and fluid viscosity, which enhanced the separation effect [26]. In 2022, Cairone et al. investigated two affordable low-light-loss waveguide fabrication techniques: 3D-printed PDMS and laser-cut PMMA. By adding a copper layer to the PDMS waveguide, the signal loss was significantly reduced [27]. In 2024, Yu Cao et al. introduced a photofluid microplatform that utilizes ultraviolet nanosecond laser technology on carbon nanotube-doped PDMS substrates. This technology enables efficient remote fluid and particle control [28]. Ou et al. proposed a microfluidic system with particle manipulation. The microfluidic chip they developed had a vortex structure comprising three microchannels, providing a new approach to low-cost manufacturing and system integration [29].

In the field of theory and simulation, Orlov formed a new chemical bond between silicon nanoparticles through compressing the quantum tunneling effect on their surfaces, representing a method of obtaining new materials [30]. Ji et al. investigated the effect of temperature and SDS concentration on the solidification morphology of wax drops at the air–water interface. This study enriched our scientific knowledge of interface materials by clarifying the mechanism behind changes in the morphology of wax droplets [31]. Cordero et al. analyzed the role of chlorosulfonic acid in graphite dispersion through DFT technology, providing a theoretical basis for the mechanism of molecular stripping. In 2023, Cordero's team studied the behavior and damage mechanisms of flax/Elium composites during stretching through a combination of techniques, including in situ microCT scanning and finite element analysis, revealing the effects of moisture aging on material properties [32]. Neil Savage used machine learning and big data technology to gain widespread access to research data for new materials. This technology accelerates the discovery of new materials [33]. In 2021, Puru Jena further accelerated the discovery of new materials by increasing the computing power and utilizing first principles [34]. Overall, these studies have deepened our understanding of material properties, and more importantly, they provide scientific guidance for the design and optimization of materials.

In recognizing the significance and relevance of the above micro- and nano-applications, I am pleased to highlight trending future research directions for the *Micro* journal. This new chapter of *Micro* welcomes original research and review articles on either a fundamental investigation or an applicational exploration of biomedical and material research, energy and environmental studies, electronic devices, industrial applications, or microfluidic technologies. We hope that the success as well as the limitations of these fields can inspire further innovation.

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