Editorial for the Special Issue on Frontiers in Advanced Ceramic Materials for Microwave Absorption

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With the rapid advancement of information technology, electromagnetic radiation has become deeply integrated into nearly every aspect of modern life, from personal communication and industrial manufacturing to aerospace and national defense infrastructures. As the electromagnetic environment has become increasingly complex and congested, electromagnetic waves have not only brought unprecedented convenience but also introduced serious challenges, including electromagnetic interference, radiation pollution, and information insecurity. Consequently, the rational design and development of microwave absorption materials (MAMs) are critically important for protecting human health, mitigating electromagnetic pollution, and strengthening information security in the information age.

Microwave absorption materials are a class of functional materials designed to convert the energy of incident electromagnetic (EM) waves into thermal energy within specific frequency ranges. Significant progress has been achieved through extensive research on a wide variety of material systems [1–5], including ferrites, magnetic metals, carbon-based materials, and emerging two-dimensional materials such as MXenes and MBenes. Notably, current research on advanced ceramic materials is shifting from single-phase systems to multicomponent composites with precisely engineered structure-property relationships. This evolution is driven by the development of structure-guided strategies such as nano/microtopology engineering, defect engineering, interface engineering, and hybrid design. Moreover, the pursuit of next-generation absorbers that are thin, broadband, lightweight, and high-strength has become a major driving force for innovation in the field.

This special issue on frontiers in advanced ceramic materials for microwave absorption, organized by Profs. Bingbing Fan, Xiaojun Zeng, Xiaomeng Fan, and Xiaoxiao Huang brought together 2 comprehensive review articles and 16 original research papers addressing these frontiers in ceramic-based microwave absorbing materials. The contributions cover a wide range of topics, including the following:

The design of multicomponent ceramic composites with tunable electromagnetic parameters.

The application of nano/microtopology engineering to construct hierarchical architectures and strengthen structure–function correlations.

The use of defects, interfaces, and hybrid engineering to control charge transport, polarization behavior, and interfacial interactions.

The development of advanced processing routes for precise microstructure and phase composition control.

The exploration of novel mechanisms governing microwave attenuation and energy dissipation in complex ceramic systems.

This collection aims to stimulate further research and cross-disciplinary collaboration toward next-generation microwave absorption materials with enhanced efficiency, sustainability, and multifunctionality.

The guest editors would like to express their sincere gratitude to all contributing authors for sharing their valuable research, to the dedicated reviewers for their rigorous and insightful comments, and to the editorial team for their continuous support and professionalism throughout the preparation of this special issue. We sincerely hope that this collection will inspire readers, foster vibrant academic exchange, and collectively promote the advancement and prosperity of the field of advanced ceramic microwave absorbing materials.

References

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