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Scattering-Regulated RP-Type Perovskite Ceramics for Radiative Thermal Protection

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ABSTRACT

Radiative heat transfer dominates thermal loading in harsh environments, creating an urgent need for materials that combine high reflectance with robust thermal stability. Here, an RP-type perovskite ceramic is explored as a promising platform for radiative thermal protection. Instead of relying on conventional multilayer interference, its optical response is tailored through microstructural design based on Mie-scattering-mediated light regulation. By rationally engineering key structural features, backward scattering is enhanced and the reflection response is broadened over a wide spectral range. Guided by this structure-design concept, a high-reflectance ceramic thermal-protection material is experimentally realized, demonstrating the feasibility of integrating scattering regulation and ceramic processing within a unified design route. More broadly, this work establishes a general strategy for developing oxide ceramics with tailored radiative properties through structure-enabled light management. The results provide a useful framework for high-temperature thermal protection, where radiative shielding and thermal insulation need to be achieved simultaneously.

KEYWORDS

RP-type perovskite; Mie scattering; high reflectance; radiative thermal protection

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