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SPECTRAL RADIATIVE PROPERTIES OF THREE-DIMENSIONALLY ORDERED MACROPOROUS CERIA PARTICLES

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ABSTRACT. Radiative properties of spherical heterogeneous particles consisting of three dimensionally ordered macroporous (3DOM) cerium dioxide (ceria) are numerically predicted in the spectral range 0.3–10 _m. The particles are 1 _m in diameter, with interconnected pores of diameter 330nm and a face-centered cubic lattice arrangement. Predictions are obtained by solving macroscopic Maxwell's equations using the discrete dipole approximation and the finite element method as a complementary means of numerical prediction. The scattering and absorption efficiency factors as well as the asymmetry factor are determined as a function of the particle orientation relative to the direction of the incident plane wave. The scattering and absorption efficiency factors show significant dependence on the particle orientation in the spectral range equal to particle diameter to 560nm. Compared to homogeneous ceria particles, 3DOM particles of identical size tend to cancel the wave extinction for wavelength greater than 560 nm. Approximating the 3DOM particles as a homogeneous sphere with properties calculated from an effective medium theory is also considered. This approach is shown to be valid only for wavelengths much greater than the pore size, demonstrating that a detailed geometrical representation of the internal particle structure is essential to obtain accurate radiative characteristics of nano-structured particles.