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论文

多层结构半透明球形粒子的辐射特性

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摘要：

基于蒙特卡罗光线踪迹法研究了半透明多壳层球形粒子的辐射性质，并通过BHCOAT程序验证其精度。对比光线踪迹法，分析了有效介质理论(effective medium theory，EMT)的应用范围，并用光线踪迹法计算了多层球形粒子内光谱吸收分布。研究结果表明，蒙特卡罗光线踪迹法适合于计算粒子尺度参数 >30的多层球形粒子辐射吸收。层间折射率和消光系数偏差较小时，有效介质理论结合Mie理论可用来近似估算多层粒子的辐射特性。当层间光学常数偏差较大时，特别是对于精度要求较高的情况，EMT-Mie理论不再适用。层间光学常数不同导致光谱辐射吸收分布显著不均匀。

关键词： 多层球形粒子　辐射特性　有效介质理论　蒙特卡罗光线踪迹法

Radiative Property of Semitransparent Spherical Particle With Multilayer Structure

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Abstract:

The radiative property of the semitransparent spherical particle with multilayer structure was studied using Monte-Carlo ray-tracing method (MCRTM), and the accuracy of this method was validated by BHCOAT code. The applicable range of effective medium theory (EMT) was analyzed in comparison with the MCRTM, by which the internal spectral absorption distribution of multilayer particle was computed. The results reveal that the MCRTM is applicable to calculate the radiation absorption of multilayer spherical particle with the size parameter more than 30. If the deviation of optical constants among layers in particle is small, the EMT in combination with the Mie theory can be used to roughly compute the effective optical constant of multilayer spherical particle. If the deviation of optical constants among layers is large, the EMT-Mie thoery is not applicable to the cases with the desire of high computational precision. For the multilayer spherical particle in which each layer has different optical constant, the internal volumetric spectral radiation absorption is not uniform remarkably.

Keywords: multilayer spherical particle　radiative property　effective medium theory　Monte-Carlo ray-tracing method

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