

现代应用光学

氙灯和发光二极管作光源的积分球太阳光谱模拟器

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摘要: 设计了一种由氙灯和发光二极管(LEDs)作光源的积分球太阳光谱模拟器来提高太阳光谱的光谱匹配精度。引进模拟退火算法匹配技术, 设计了氙灯模块及LEDs模块的结构和控制系统。LEDs采用环带摆放和恒流驱动方式, 并通过多机通信系统控制。氙灯模块止滤光片和程控衰减器, 滤光片用来滤去氙灯红外波段的尖峰, 衰减器则用来调整氙灯入射到积分球的辐射通量。仿真实验表明: Epitex 53种单色LEDs和氙灯完全可以模拟380~1000 nm波段的AM 1.5标准太阳光谱, 光谱的平均相对误差为5.67%。分析讨论了该模拟器的光谱失配误差、出光面的辐照非均匀度和辐照不稳定性, 三者均可以控制在±3%以内。

关键词: 氙灯 发光二极管 积分球 太阳光谱模拟器 光谱匹配

Design of integrating sphere solar spectrum simulator based on xenon lamp and LEDs

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Abstract: By taking a xenon lamp and Light Emitting Diodes(LEDs) as luminescence media, an integrating sphere solar spectrum simulator was proposed to improve the matching precision of solar spectra. The Simulated Annealing (SA) algorithm was introduced to study spectrum matching technique, and the mechanical structures and control systems of LED module and xenon lamp module were designed. The LEDs were positioned in an annular manner, driven by a constant current and controlled by a multi-computer communication system. A cut-off filter and a programmable attenuator were mounted in the xenon lamp module, a filter was used to cut off the infrared spectrum of xenon lamp and an attenuator was used to vary the incidence radiant flux of xenon lamp entered in the integrating sphere. The simulation experiment indicates that 53 Epitex LEDs and the xenon lamp could simulate the AM 1.5 standard solar spectra successfully, and the average relative error is 5.67%. The mismatching error, irradiance uniformity and the irradiance instability were analyzed and discussed, and they all have the potential of performing better than ±3%.

Keywords: xenon lamp Light Emitting Diode (LED) integrating sphere solar spectral simulator spectrum matching

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