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材料合成及性能

染料掺杂聚合物光纤的荧光及其光谱下转换性质

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摘要： 为了拓展染料掺杂聚合物光纤的应用范围，利用甲基丙烯酸甲酯（MMA）单体合成了掺有Coumarin 540和Rhodamine 6G两种激光染料的聚甲基丙烯酸甲酯（PMMA）聚合物玻璃棒，并将其拉制成直径约1 000 μm的聚合物光纤。以市售LED灯为光源，在侧向照明和前端照明两种条件下分别研究了染料掺杂的聚合物光纤中染料的荧光、荧光传输损耗以及光纤的光谱下转换等性质。两种染料的Stokes波长红移幅度分别达到70 nm和50 nm。在掺杂浓度分别为0.01 mg/g 和 0.04 mg/g时，侧向照明条件下测得两种光纤分别对520 nm和577 nm的荧光的传输损耗为0.336 cm^{-1}和0.343 cm^{-1}。在前端照明条件下，在光纤输出端获得了较高下转换效率的光谱输出，其转换效率与染料掺杂浓度和光纤长度有关。这种染料掺杂的聚合物光纤有可能与石英玻璃光纤耦合，对其所传输的光进行光谱下转换的光频调控以更好地满足不同的应用需求。

关键词： 荧光 吸收 光谱下转换 染料掺杂 聚合物光纤

Fluorescence and Spectral Down-conversion Characterization of Dye-doped Polymer Fibers

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Abstract: To extend the application of dye-doped polymer fibers, polymethyl methacrylate (PMMA) rods doped with Coumarin 540 and Rhodamine 6G laser dyes were synthesized with methyl methacrylate (MMA), and drawn to fibers with 1 000 μm diameters. The fluorescence and fluorescence transmission loss of the dyes and the spectral down-conversion properties of the dye-doped polymer fibers were studied under side illumination and front surface illumination conditions, where a commercial LED lamp was used as illumination source. The Stokes shifts of these two dyes doped in PMMA matrix were found to be 70 nm and 50 nm, respectively. Under side-illumination condition, 0.01 mg/g and 0.04 mg/g dopant concentrations, the transmission loss of the fibers for 520 nm and 577 nm fluorescence were determined to be 0.336 cm^{-1} and 0.343 cm^{-1}, respectively. Under front surface illumination condition, the down-converted spectral outputs from the end of the fibers were observed with high conversion efficiency which was relative with dye concentration and fiber length. The dye-doped polymer fibers are possible coupled with silica fibers to modify the frequencies of the light transmitted by the silica fibers to better satisfy different application requirements.

Keywords: fluorescence absorption spectral down-conversion dye-doped polymer optical fiber

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