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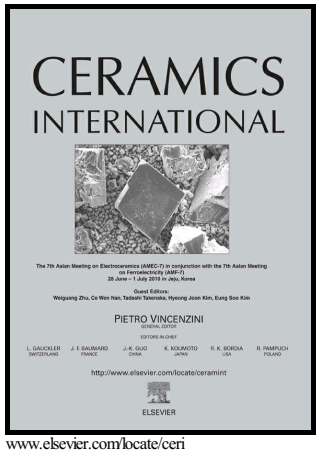

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Preparation and characterizations of Yb:YAG-derived silica fibers drawn by on-line feeding molten core approach

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Abstract

Three Yb:YAG transparent ceramics with Yb_2O_3 doping concentrations of 1, 10, and 15 at.%, respectively were made into silica-clad hybrid fibers using an on-line feeding molten core approach. The diffusion of silica was mitigated such that the lowest SiO_2 concentration was 36.4 wt.%, and consequently, the Yb_2O_3 content could reach 8.93 wt.% in the fiber core. The fiber core transformed from a YAG ceramic to an yttrium aluminosilicate glass, and the formation of abundant Q^2 silicate species implied that the structure of the core glass maintained some environments similar to that of YAG with Q^2–AlO_4 tetrahedra. The absorption and emission spectra of the obtained fibers were compared to those of Yb:YAG ceramics, and the self-absorption effect was analyzed in detail. All three fibers could output lasers under 940 or 970 nm pumping. The maximum output power of the Yb:YAG-derived fibers was higher than that of ceramic wafers owing to the cladding pump technology, which offered a new method to improve the application of ceramics.

Keywords: B. Fibers; C. Optical properties; D. Silicate; Yb:YAG Ceramics

1 Introduction

Yb-doped fiber lasers play a prominent role in many practical applications. Ytterbium has some advantages, such as a simple energy level structure, broad absorption and emission bands, long upper-level lifetime, and high efficiency [1]. In order to increase the output power and suppress nonlinear effects, short fibers with high doping concentration are indispensable. However, the solubility of rare earth ions in silica glass is generally low, and the formation of clusters and defects reduces radiative transitions and consequently the