Development of new transparent ceramics for laser applications in the 1.7 – 2.7 μm window

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Abstract

Optoelectronic devices operating in the mid-infrared region are useful for many applications such as telecommunications, defence and healthcare. To improve the efficiency of such devices, it is important that compact, high-energy laser sources in the 1.7 - 2.7 μm window, are developed1. In order to produce mid-infrared laser emission, a gain material, whose emission extends beyond the NIR, can be used. In this work, the Ho3+ ion was chosen as the optically active element due to its 5I7 - 5I8 transition between 1.95 and 2.15 μm2,3. The aim of this project is to explore the (Gd1-xHox)O3 - Ga2O3 - Nb2O5 phase diagram in order to synthesise new transparent ceramics that can be used as laser gain media. In principle, these transparent ceramics would be easier and cheaper to synthesise than the usual single crystals. In addition, it is possible to use higher concentrations of dopant than in the case of single crystals4. The syntheses were carried out by out-of-equilibrium phase crystallisation from the glass or deeply undercooled melt using aerodynamic levitation coupled with laser heating (CO2). This technique has several advantages over the conventional synthesis method of obtaining ceramics by powder sintering. Firstly, the sample can be heated to a very high temperature (up to 3000◦C), the cooling rate is of the order of several hundred degrees per second, and finally the sample is levitated, which prevents any heterogeneous crystallisation by contact during cooling. The structural and optical properties of the new phases are then studied.

Keywords: Aerodynamic leviation, glass, ceramic, crystallization, X, Ray diffraction

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