doped Y2O3 laser. Our estimates based on the experimental results above as well as host material characterization indicate that this new ceramic laser material could potentially be suited for almost any solid-state based laser system currently under development. Experimental results on acousto-optic Q-switching of the quasi-CW diode-pumped Yb-doped Y2O3 laser are also presented.

6216-21, Session 5

Spectroscopic properties and laser operation of RE3+-ion doped garnet materials

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There has been considerable interest in the trivalent rare earth-ion-doped ceramic laser materials because of its numerous advantages over melt growth methods, including faster production times, solid solution allowing the fabrication of multi-phase transition materials, highly homogeneous materials and the ability to engineer profiles and structures before sintering. Much progress has been made in improving the optical quality from ceramics, as well as exploring new materials. Successfully developed concentrated Nd:YAG ceramics was opened the way for drastic heat reduction by directly upper laser level pumping. In this present, after the spectroscopic investigation of rare-earth doped garnet materials includes ceramics, we report about the heat generation properties with the radiative quantum efficiency. Lately developed RE3+-ion-doped disordered laser ceramic materials, Y3ScxAl5-xO12, which are a solid solution of YAG and Y3Sc2Al3O12 (YSAG), have been interested in because of its compositional tuning of parameter x. The disordered Y3ScAl4O12 (YAG/YSAG) ceramics exhibit relatively low minimum pump intensity (Imin) and broad emission bandwidth. The value of Imin in the Yb:Y3ScAl4O12 ceramics was found to be 2/3 compared with the Yb:YAG single crystal under 970nm zero-line pumping. Efficient laser oscillation of 72% slope efficiency was obtained for input power. Next, we have demonstrated passively mode-locked Yb:Y3ScAl4O12 disordered ceramic laser by using a semiconductor saturable-absorber mirror. Pulses as short as 280 fs having an average power of 62 mW at 1035.8 nm was obtained. As a conclusion, the possibility of tailored fluorescence spectral profile in layer-by-layer type ceramic composite will be discussed.

6216-22, Session 5

Efficient diode-pumped cw Tm:KLu(WO4)2 laser

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Diode-pumped Tm-lasers operating in the eye-safe spectral range near 2 μm have potential applications in rangefinding, remote sensing, and pumping of mid-IR OPOs for directed countermeasures. However, so far only two crystalline hosts (YAG and YLF) provided multiwatt powers in the cw regime while the results with vanadates (YVO4 and GdVO4) were quite modest. The strongly anisotropic monoclinic double tungstates are known for their large absorption and emission cross sections and broader lines of the rare earth dopants which makes them preferable for diode pumping. In the case of Tm the position of the absorption peak near 800 nm is also more suitable for AlGaAs laser diodes than YAG or YLF.

For the first time to our knowledge we grew Tm-doped KLu(WO4)2 crystals with high optical quality and obtained cw laser oscillation with a commercial 20 W diode bar. Only simple beam shaping optics was used for the 802 nm pump beam. The 2.9 mm thick, uncoated, 3 at % Tm-doped KLu(WO4)2 (Ng-cut) was positioned in a nearly hemispherical 50 mm long cavity close to the plane mirror through which the laser was pumped. Room temperature was maintained by water cooling the crystal. With 3% output coupler (RC=50 mm) the polarized output at 1950 nm reached 4 W for 15 W of incident pump power. The slope efficiency with respect to the absorbed pump power amounted to 69% and the maximum optical efficiency reached 47%. It is the first time such high powers were generated with Tm-doped monoclinic double tungstates.

6216-23, Session 5

Recent advances in onshore produced ceramic laser gain materials

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Recent developments at Raytheon (sponsored by JTO and by AFRL) will be presented, including fabrication and characterization of laser quality undoped, Yb-doped and Nd-doped ceramic YAG.

6216-24, Session 6

Middle-infrared luminescence of rare-earth ions in silver halide crystals

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Middle Infrared Lasers for countermeasures against heat seeking missiles are currently under development. These systems, based on diode pumped solid state lasers pumping optical parametric oscillators, are complex, bulky and expensive. Middle-IR fiber lasers in the 3 to 5 micron spectral region without the need for frequency conversion may provide an attractive alternative to the systems under development

We have developed fibers made of AgClxBr1-x crystals that are highly transparent in the spectral range 3-25 micron, flexible, insoluble in water and bio-compatible. These fibers could be useful as host materials for amplifiers and lasers in the middle-IR due to their extremely low phonon frequencies, lower than 100 cm-1.

We have incorporated Nd3+, Pr3+ and Tb3+ ions into AgClxBr1-x crystals and investigated the spectroscopy of these ions in the middle-IR. The absorption, emission, and the kinetic parameters were measured. High quality AgClxBr1-x fibers were extruded from rare earth doped single crystals. In all these crystal and fibers strong middle IR luminescence was found.

The optical parameters of the activated crystals were estimated using the Judd-Ofelt approximation.

The strong middle-IR luminescence and the kinetic parameters of these crystals make them good candidates for the fabrication of fiber lasers in 4 -5.5 micron spectral range.

6216-25, Session 6

Advances in bonded YAG composite laser gain media

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A review of Synoptics efforts in bonding undoped yttrium aluminum garnet (YAG) and Nd:YAG single crystals and ceramics, for optically and mechanically robust high power solid state laser designs will be presented. Data on the necessary surface preparation for optical quality bonds, including atomic force microscopy (AFM) and flatness will be shown. Optical characteristics of composites with one or more bond interfaces in slab or test coupon form were examined. Insertion loss, stress birefringence, transmitted wavefront distortion, and optical microscopy results will be presented. Bond mechanical strengths were characterized using thermal shock and 4-point flexure tests. Flexure test results were analyzed using Weibull statistics and fractography, illustrating the medium-high and high energy failures observed in bonded YAG sets with average strengths (>445MPa), higher than those of as-grown YAG crystals (409MPa with no post growth anneal). Acid etching of flexure specimens was observed to add a fine notch to bond interfaces, but although the etching generally tightened strength distributions, measured mean strengths of