Gd3+, Lu3+ co-doped KY(WO4)2:Yb3+ planar waveguide lasers at 1025 and 980 nm

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Resume : Single-crystalline layers of KY(WO4)2:Yb3+ co-doped with Gd3+ and Lu3+ have been grown onto pure (010) oriented KY(WO4)2 (KYW) substrates by vertical liquid phase epitaxy. The Yb3+ concentration is optimized to 1.2-2.4at.% for application of these layers as planar waveguide lasers near 1 μm, yielding a refractive index contrast between layer and substrate of 6×10-4. Both co-dopants, Gd3+ and Lu3+, are optically inert but possess higher electron densities than Y3+, thus co-doping a total of 40% of these ions significantly increasing the refractive index contrast by an order of magnitude to 7.5×10-3 without affecting the optical properties of the layer.
This allows for a significant reduction of the layer thickness to 2-4 μm for single-mode guiding, thus facilitating micro-structuring and making the layer suitable for active integrated optical devices. Two main advantages of this method are its nearly constant refractive index contrast over a wide range of Yb3+ doping level, because Yb3+ can now replace Lu3+, and the ability to engineer good lattice matching by adjusting the amounts of Gd3+ and Lu3+ ions in the KYW:Yb3+ layer. The grown layers resulted in a planar waveguide laser with butt-coupled mirrors operating at 1025 nm with a record-high slope efficiency of 82.3% versus absorbed pump power, and an output power of 195 mW. Another laser experiment without the use of an outcoupling mirror revealed laser emission at the zero-phonon line at 981 nm, with a slope efficiency of 71% versus absorbed pump power.