Laser Action in Single Crystal Fiber with High Doping Gradient

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In this work, we present for the first time, laser action in a 1cm in length and 0,7mm in diameter Nd: $LiYF_4$ single crystal fiber grown by the μPD method, specially adapted to grow fluoride fibers.
Among crystalline materials for solid-state lasers, lithium yttrium fluoride ($LiYF_4$) has proven to be an attractive host for Ho^{3+}, Er^{3+}, and Nd^{3+} doping. This is due to its advantages over other hosts, such as YAG, which include a natural birefringence that overwhelms the thermal induced birefringence eliminating problems of thermal depolarization presented by optically isotropic hosts and a much smaller thermal lens that permits good beam quality. Nd:YLF also offers fluorescence lifetime twice larger than Nd:YAG, which provide a larger energy storage.
Considering the geometry of the active medium, the single crystal fibers have the advantage of presenting the qualities of both, fibers and bulk crystals. They provide for good overlap between pump and laser active volume and present the desirable spectroscopic characteristics of bulk crystals. In order to make single crystal fibers of low production cost usually one uses either the micro-pulling-down method (μPD) or the laser heated pedestal (LHPG). Fibers may also be obtained starting from laser rods grown by the Czochralski (Cz) method. However, this latter method is more costly and needs a longer time for preparing a fiber. The fiber was placed inside a plano-concave laser cavity and pumped at the 805nm absorption peak of the host material. Laser action at 1047nm or 1053nm was achieved, depending on the angle between spherical mirror and fiber axis. Beam quality was good for both wavelengths. The output power was 246mW for an absorbed pump power of 3W.