Optimization of the growth conditions of a cylindrical bar grown in a vacuum by edge-defined film-fed growth method

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The main purpose of this paper is to find those values of the die radius r_0, pulling rate v and melt temperature T_0 at the meniscus basis which assure the growth of a Nd:YAG and a Nd:YVO_4 monocrystal cylindrical bar respectively, with a prescribed diameter 2rf and for which the nonuniformities of the surface of the bar, due to small uncontrollable oscillations of the pulling rate v and melt temperature T_0 are minimum possible. Numerical results are given for a Nd:YAG and Nd:YVO_4 cylindrical bars of 5 mm diameter, grown in a furnace in which the vertical temperature gradient is k=33 K/mm. For a value of the pulling rate v in the range 0.0001 to 0.53 mm/s and a value of the melt temperature T_0 in the range 2244 to 3000 K for Nd:YAG, and 2084 to 2240 K for Nd:YVO_4, respectively, four type of uncontrollable oscillations Oi, i=1,2,3,4, of these parameters are considered: O1= (v=$\pm$0.001 mm/s and T=$\pm$1 K), O2= (v=$\pm$0.01 mm/s and T=$\pm$10 K), O3= (v=$\pm$0.02 mm/s and T=$\pm$20 K), O4= (v=$\pm$0.001 mm/s and T=$\pm$30 K). For a set of six values of the die radii r0 in the range 2.6 to 4.0 mm the amplitude of the crystal radius variation due to the above four oscillations is computed.

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