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Numerical Analysis of Er-doped DFB Fiber Laser: Er ion Concentration and Output Power Optimization

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In this paper the dependence of Er-doped distributed feedback (ED-DFB) fiber laser output power on Erbium ion concentration is investigated theoretically. Numerical results show that by increasing ion concentration, the output power reaches a maximum and decreases for very high ion concentrations due to homogeneous up-conversion effect. Maximum value of output power of the ED-DFB fiber laser depends on the pump power and takes place at different concentrations. It is shown that the up-conversion effect gives rise to an increase in the pump power threshold. The structure of the DFB fiber laser considered in this work is 5 cm long with a phase shift of $\pi/2$ at the center of the grating. The up-conversion effect is modeled by adding a term to the rate equations. Numerical calculations are performed by self-consistent solution of rate equations and coupled wave equations using transfer matrix method for $\lambda = 1.55\mu\text{m}$.

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