Linear Optical Analysis of Microdisk Lasers Concentrically Coupled with Microrings

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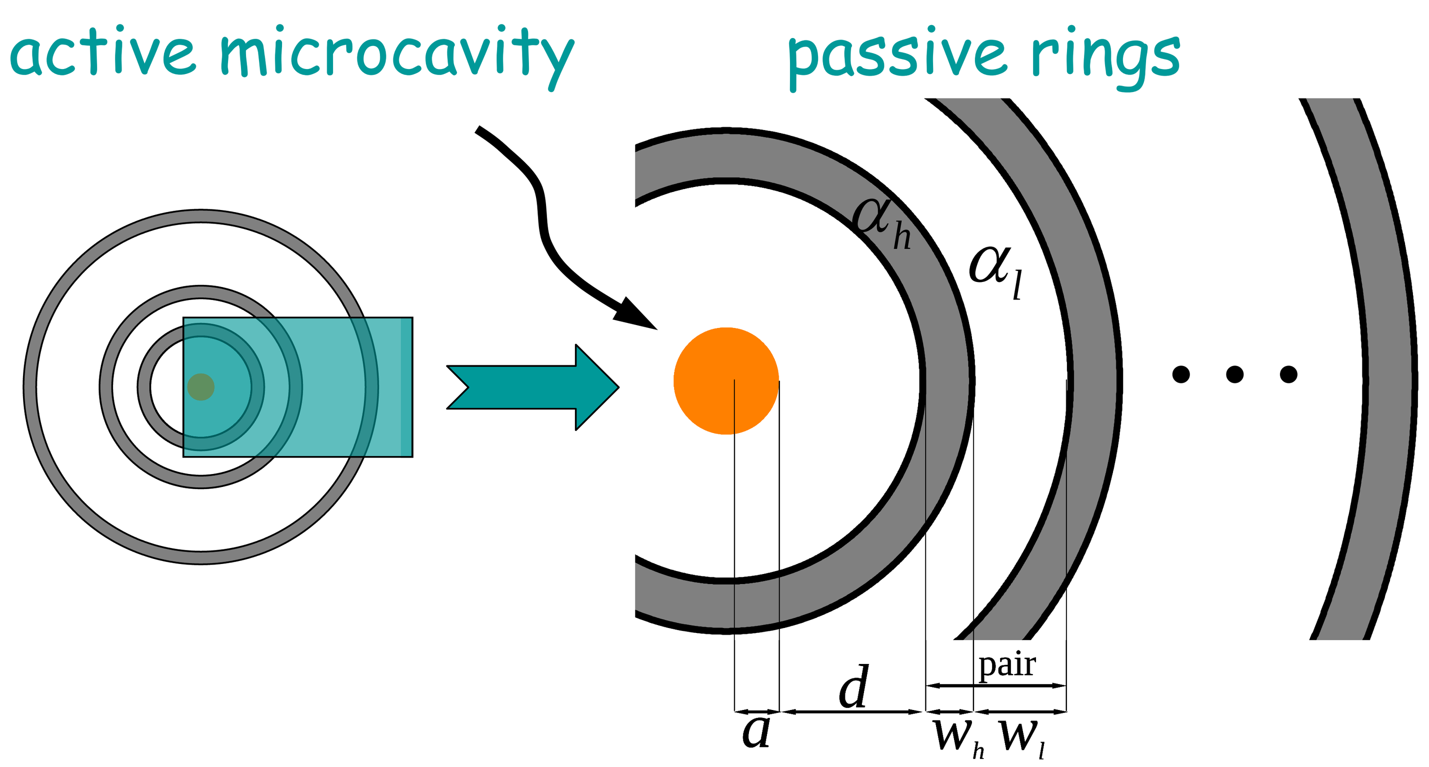
OBJECT OF RESEARCH

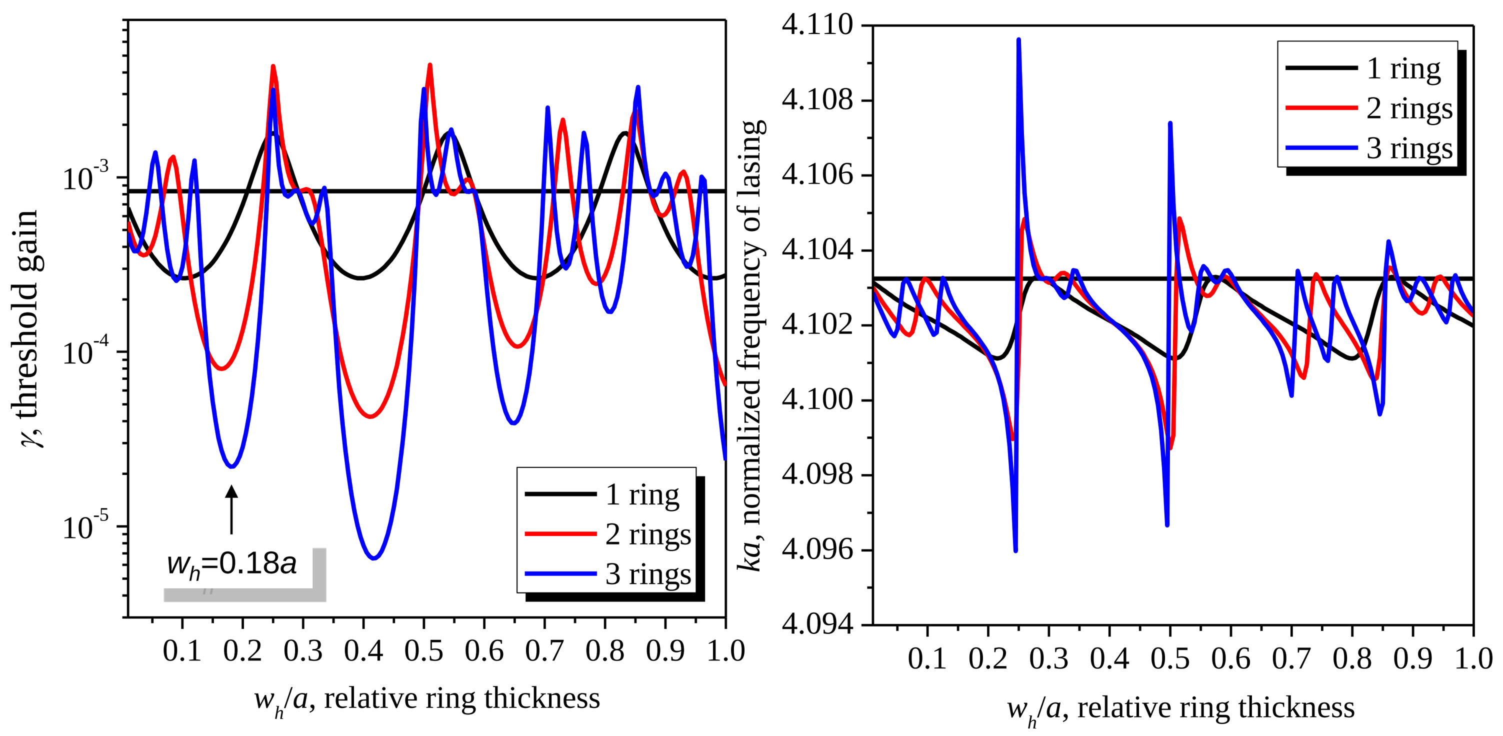


$$\alpha_l = 1, \alpha_h = 3.374 \quad \text{(GaAs/InP)}; \quad w_h / w_l = \delta$$

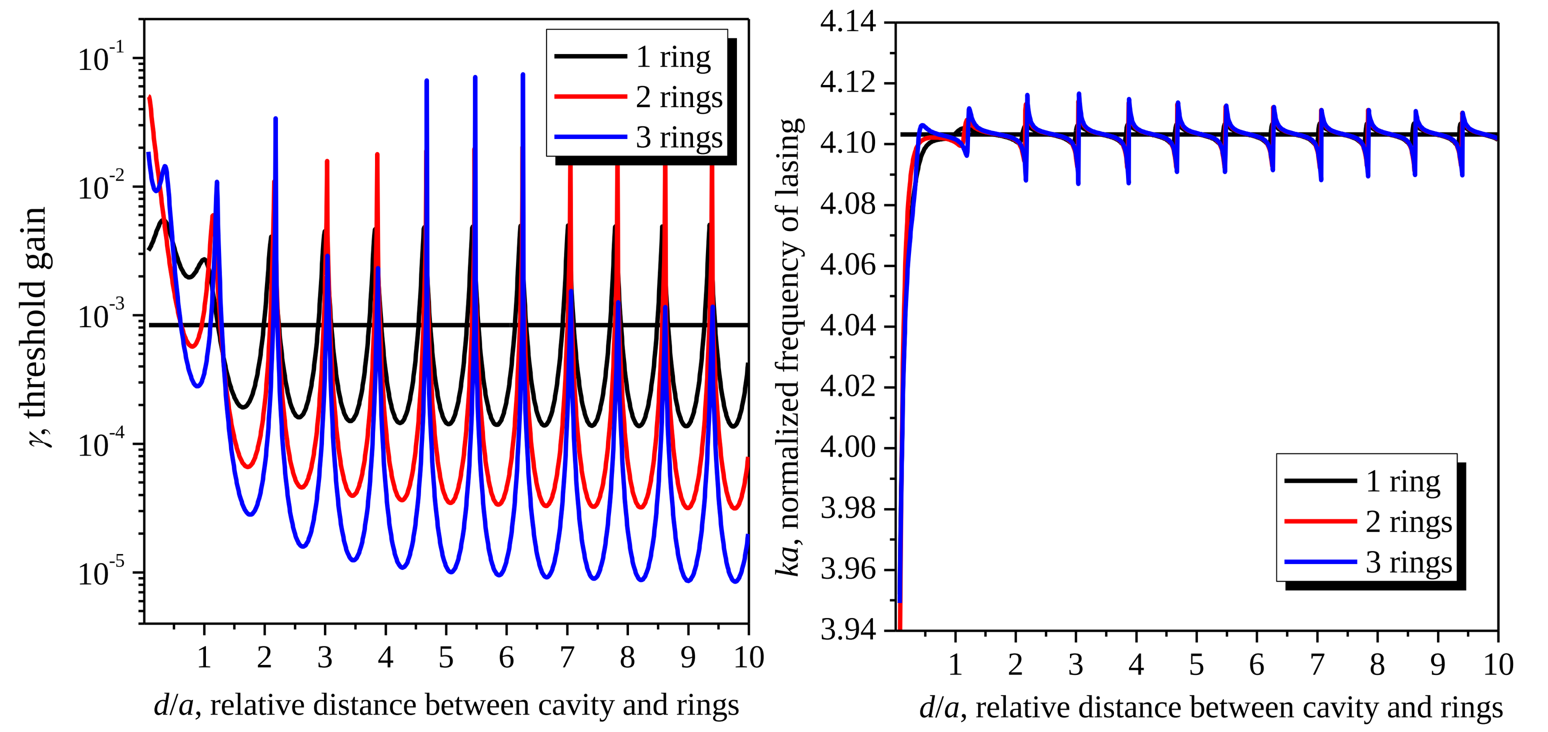
ABSTRACT

The lasing spectra and thresholds of a microdisk laser concentrically coupled with external microrings are investigated using the recently developed formalism of the Lasing Eigenvalue Problem (LEP). The influence of the microrings on the lasing frequencies and threshold values of material gain is studied, and the dependences of frequencies and thresholds on the geometrics are presented.

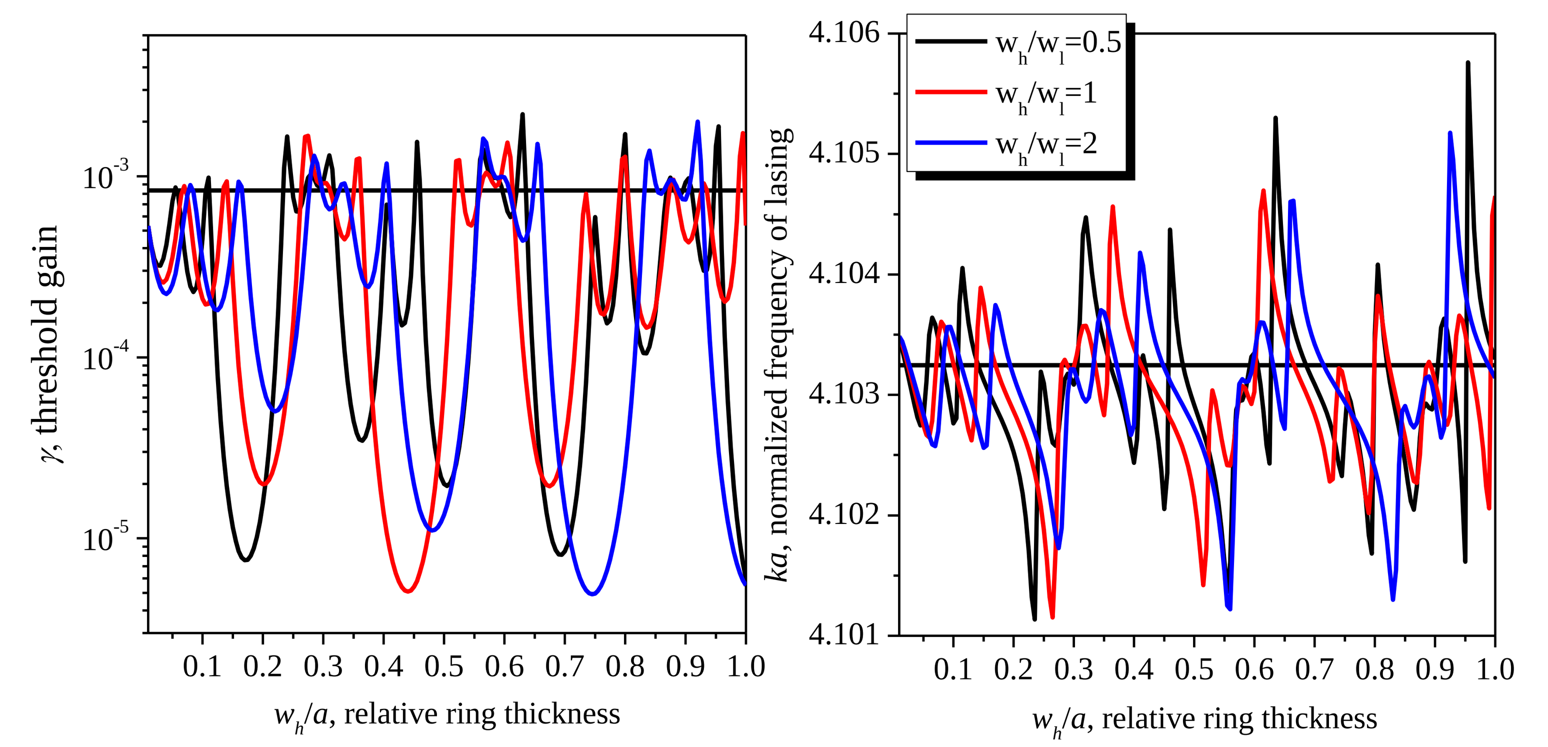
NUMERICAL RESULTS



(I) Dependences on ring thickness for the mode $(H_z)_{7,1}$, $d = 10a$, $\delta=1$.



(II) Dependences on the distance between microcavity and rings for the mode $(H_z)_{7,1}$, $w_h = 0.18a$, $\delta=1$



(III) Dependences on the ring thickness for the mode $(H_z)_{7,1}$ in a microcavity coupled with 3 rings for different values of δ, $d = 1.75a$

MODELLING

M is a number of contours

H_z polarization, $\{H_z, E_\rho, E_\phi\}$; time dependence $\sim e^{-ikct}$

Lasing egenvalue problem (LEP)

$$\begin{cases} \left(\Delta + k^2 \nu^2\right) H_z(\rho,\varphi) = 0 \\ E_\varphi^s = E_\varphi^{s+1}, \quad H_z^s = H_z^{s+1}, \quad s = 1,\ldots,M \\ \text{Radiation condition at infinity} \end{cases}$$

$$\nu_s = \alpha_s, \quad s = 2,\ldots,M, \quad \nu_1 = \alpha_1 - i\gamma$$

The eigenvalue are pairs of real numbers (ka, γ)

CONCLUSIONS

Lasing thresholds are affected by the following factors:

(1) distance from the active cavity to rings

(2) ring thicknesses

(3) ratio of thicknesses of high- and low- contrast rings

(4) number of rings. Adding a new pair of high- and low- contrast rings of proper widths lowers the thresholds by an order of magnitude.