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Microlasers and Microfilters: Principles and Possible Applications

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Microlasers grown on a chip without any distributed Bragg reflectors to provide the feedback are potentially useful for integrated optics, particularly if the laser emission in the plane is unidirectional and this direction can be switched. Microfilters performing as add/drop devices and bandpass units are now considered the most needed optical element for the DWDM field. The talk will concentrate on our research effort in GaN microlasers with non-circular shapes and in dielectric microfilters with oval and square shapes,

By using wave and ray descriptions, review is made of whispering gallery modes (WGMs), other stable modes, and chaotic modes in non-circular micropillars, acting as 2-dimensional resonators with high Q values. For WGMs and some stable modes, the coupling into and leakage out of the resonator is with evanescent waves associated with total internal reflection at the side wall. For rays with chaotic trajectories, the input and output coupling is with propagating waves that obey the Snell'sLaw of refraction. A brief introduction of Poincare surface of section (SOS) is presented for non-circular-shaped 2-D resonators. In order to verify the predictions from the SOS diagrams, a new experimental technique is used to measure simultaneously the following two quantities: (1) where on the side wall is the microlaser radiation exiting (leaking with the refracted rays)?; and (2) what is the angle of the emission?

Recent results on the angular distribution from GaN micropillars (2 μm in height) lasers of a variety of shapes and pumping conditions will be presented. In addition, I will present recent findings of a series of transfer function peaks for resonator with an oval cross section and the recent understanding in 2-D wave-vector space of the multimode nature of a square resonator that has potential as add/drop filters.