SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

OPTICAL MICRORESONATORS WITH APPLICATIONS TO LASING AND SINGLE NANOPARTICLE DETECTION

DISSERTATION DEFENSE
by

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Abstract: Whispering gallery mode (WGM) microresonators have attracted great interests due to the significantly enhanced light-matter interactions originating from their high quality factors and small mode volumes. They are suitable for a wide range of applications including sensing, lasing, nonlinear optics, and so forth. However, temperature fluctuations as one of the most common environmental noises disturb the cavity resonances and thus degrade the device stability and sensitivity. We introduce a wetting technique to coat a silica resonator with a thin layer of polymer which has negative thermo-optic coefficient to compensate for the thermal effect in silica, and demonstrate complete thermal compensation.

WGM microresonators have shown great promise for ultra-sensitive and label-free chemical and biological sensing by probing the surroundings with evanescent waves leaking out of the resonator. Sensing is achieved by monitoring either the shift or splitting of a resonant frequency. The detection limit is determined by the linewidth of the resonant mode which is ultimately limited by the material absorption introduced loss. To surpass the limit of passive resonators, we report real-time single nanoparticle detection using on-chip WGM microcavity lasers. The ultra-low threshold microlasers are prepared by doping WGM resonators with rear-earth ions through sol-gel method, and their linewidths are much narrower than their passive counterparts. The detection approach relies on measuring changes in the heterodyne beat note of two split modes originating from splitting of a narrow emission line in the microlaser induced by nanoscale objects. We demonstrate detection of polystyrene and gold nanoparticles as small as 15 nm and 10 nm in radius, respectively, and Influenza A virions by monitoring changes in the beat note of the split lasing modes. The self-heterodyne interferometric method achieved in the on-chip microlaser provides a self-referencing scheme with extraordinary sensitivity, and paves the way for detection and spectroscopy of nano-scale objects using micro/nano lasers.

DATE:	Thursday, January 12, 2012
TIME:	11:00 a.m.
PLACE:	Green Hall, Room 0120

Dissertation advisor:
Dr. Lan Yang

This seminar is in partial fulfillment
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