SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

WHISPERING GALLERY MODE MICRORESONATORS: APPLICATIONS FROM OPTICAL SENSING TO COMMUNICATIONS

DISSERTATION DEFENSE
By

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Abstract: Whispering Gallery Mode microresonators have emerged as an ideal platform for both fundamental studies and applications ranging from cavity QED to sensing and photonic integrated circuit because of their high quality factor, small footprint and ease of fabrication. In this thesis, silica whispering-gallery-mode (WGM) microresonators are explored as building blocks of photonic circuits as well as ultrasound detectors.

First, I will introduce a WGM microresonator based add-drop filter (ADF) and show how the drop efficiency, bandwidth and crosstalk of this system, are related to different loss mechanisms. Add-drop Filters are known as an essential element of wavelength division multiplexing systems in optical communication. By improving the fabrication technique, we enhance the robustness and demonstrate the thermal tuning capability. I will also discuss the effect of optical gain on the performance of the WGM microresonator ADF and show that by tuning the gain, one can finely control the characteristics of the ADF. Optical gain medium is implemented using a sol-gel technique in which Erbium and Ytterbium ions are codoped into silica glass.

Next, opto-mechanics is introduced and I will explain how optical chaos can be achieved by optically pumping a microtoroid resonator. Synchronized chaotic signals can be used for secure communication. Therefore, we study how to create two chaotic signals and how to increase their correlation. To achieve this class of resonators for photonic application, it is crucial to show that they can be fabricated with different materials. We study the fabrication of TiO2 microdisks using sol-gel technique and show that high quality-factor resonance (~105) can be achieved using this CMOS compatible material. These new resonators are also promising devices for many applications such as light harvesting and UV sensing.

Finally, I will discuss the capability of microresonators for ultrasound sensing and prove that very high sensitivity and low detection limit can be achieved using an encapsulated robust microtoroid. I will also show that one can lower the detection limit and increase the sensitivity by designing the microtoroid such that it has an intrinsic mechanical resonance near the frequency of the ultra-sound signals. Using optical resonators for ultrasound sensing implies their applications for an alloptical photo-acoustic imaging system.

DATE: Friday September 12, 2014
TIME: 2:00 p.m.
PLACE: Green Hall, Room 0120

Dissertation advisor:
Dr. Lan Yang

This seminar is in partial fulfillment
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SCHOOL OF ENGINEERING & APPLIED SCIENCE