Notice of the Final Oral Examination
for the Degree of Master of Applied Science
of
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BSc (University of Tehran, 2011)

“Beam Propagation Modelling of Whispering Gallery Microcavities”

Department of Electrical and Computer Engineering

Thursday, April 30, 2015
12:00 P.M.
Engineering Office Wing
Room 430

Supervisory Committee:
Dr. Tao Lu, Department of Electrical and Computer Engineering, University of Victoria (Supervisor)
Dr. Aaron Gulliver, Department of Electrical and Computer Engineering, UVic (Member)

External Examiner:
Dr. Martin Byung-Gak Jun, Department of Mechanical Engineering, UVic

Chair of Oral Examination:
Dr. Slim Ibrahim, Department of Mathematics and Statistics, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies
Abstract

Whispering Gallery Mode (WGM) microcavities have a wide range of applications due to their ultra high quality factor ($Q$), from fundamental physics research to engineering applications. From the basic principle of a WGM cavity, a nano particle bound to the surface of a cavity will result in a resonance wavelength shift. In the last decade lots of research have been conducted on this topic and high sensitive biosensors have been introduced using this phenomenon. This thesis presents an efficient simulation tool to study the WGM cavities. The method is then characterized by investigating different properties of such cavities. The perturbation caused by a polystyrene nano bead attached to the surface of a WGM silica microcavity is efficiently modeled. Furthermore, an approach to enhance the sensitivity of this sensing method by at least a factor of three is proposed. The main advantage of this approach comparing with other sensing enhancement methods is that the quality factor will remain above 108 for sub-50\textit{nm} radius particles. Finally, in the application chapter, the cavity-waveguide coupling, huge WGM cavities, and deformed microcavities are modelled. Also the asymmetric cavities are investigated to see how much fabrication error is tolerable to have negligible quality factor degradation and also to study the additional radiation pattern arise from different cavity deformations.