University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Applied Science

of

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BEng (University of Victoria, 2014)

"Feasibility of Fiber Optic Sensors in Sensing High Refractive Index for the Potential Application of Acquiring Solubility and Diffusivity of Gases and Supercritical Fluids in Polymers"

Department of Mechanical Engineering

Thursday, July 21, 2016
1:00 P.M.
Engineering Office Wing
Room 502

Supervisory Committee:
Dr. Martin Jun, Department of Mechanical Engineering, University of Victoria (Co-Supervisor)
Dr. Patrick C. Lee, Department of Mechanical Engineering, UVic (Co-Supervisor)
Dr. Peter Wild, Department of Mechanical Engineering, UVic (Member)

External Examiner:
Dr. Tao Lu, Department of Electrical and Computer Engineering, UVic

Chair of Oral Examination:
Dr. Hao Zhang, School of Business, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Many properties of polymers can be affected by dissolving gases and supercritical fluids at high temperatures and pressures. Solubility and diffusivity are crucial parameters in polymer processing applications that indicates the content of gases and supercritical fluids in a polymer. Hence, different devices for measuring solubility and diffusivity have been researched, but most of the devices used today are very complex, expensive, and requires long experiment time. In this final thesis, the feasibility of fiber optic sensors as measurement devices for solubility and diffusivity of gas/SCF in polymers have been investigated. Many of the polymers used in polymer processing have high refractive index, from 1.40 to 1.60. However, most of the refractive index sensors based on fiber optics only operate in refractive index ranges of 1 to 1.44 because once the surrounding refractive index becomes greater than that of cladding, the total internal reflection is lost and only small portion of the light propagation occurs. This final thesis first reviews the current methods to measure solubility and diffusivity of gases and supercritical fluids in polymers. In addition, different types of fiber optics sensors used for sensing the refractive index are reviewed. Then, the thesis presents cost efficient, but effective fiber optic refractive index sensors, which are the silver nanoparticle coated LPG sensor, uncoated PCF MZI sensor, silver nanoparticle PCF MZI sensor, and the transmission intensity based gap sensor, to sense the surrounding refractive index in the region greater than the cladding, for the future application of solubility and diffusivity measurement. Moreover, future works that would help in sensing solubility and diffusivity of gas in polymers are also proposed.