It is clearly seen that nitro substituent, [Pn1] and [Pn5], exhibits a low fluorescent intensity The emission spectra of condensation polymer containing 4-chloro-2,5-diphenyloxazole moiety in polymer backbone studied in THF are shown in Figure 4.15.

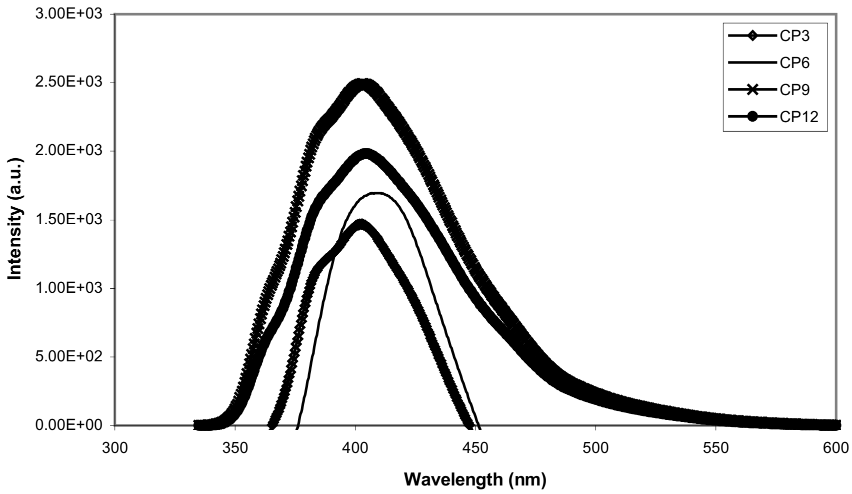

Figure 4.15 Emission spectra of **[CP3]-[CP12]** at the same concentration

4.6.3 Quantum yield

The highest fluorescent quantum yield is observed for **[P1]**, (ϕ_f = 0.62).The 1% feed amount of 4-chloro-2,5-diphenyloxazole chromophore gave a higher fluorescent quantum yield than 5%. The high concentration of 4-chloro-2,5-diphenyloxazole moiety probably quench the fluorescence resulting a lower fluorescent quantum yield.

Chapter V
Conclusion

Novel monomers containing 4-chloro-2,5-diphenyloxaolze moiety have been successfully synthesized with reasonable yield via a cyclization of the benzoyl cyanide derivatives and corresponding benzaldehyde. These monomers have been tailored for further react with methyl methacrylate and bisphenol A, in order to make a polymer containing 4-chloro-2,5-diphenyloxazole moiety as a pendent chain and in the polymer backbone by free radical and condensation polymerization, respectively.

In term of free radical polymer, acrylate monomers with various substituents including H, F, OCH_3 and NO_2 were copolymerized with methyl methacrylate (MMA) in a different feed ratio, 1% and 5%. These polymers showed a high thermal stability in the range of 247-280^{o}C due to strong dipolar interactions in the solid state between 4-chloro-2,5-diphenyloxazole moiety in the polymer side chains. The glass transition temperature (*T*g) valued in the range of 114-128oC and only one transition was observed. Thus, these polymer are substantially amorphous in the solid state.

4-Chloro-2,5-bis-(4-fluorophenyl)oxazole monomer was condensed with bisphenol A to make a poly(aryl ether). The optimum polymerization time to obtain a high molecular weight was around 9 h. These poly(aryl ether)s exhibited an excellent thermal stability ranging from 334-364^{o}C and *T*g valued in the range of 171-205^{o}C.

These two types of polymers containing 4-chloro-2,5-diphenyloxazole have been evaluated the optical properties. All polymer showed the maximum absorption and emission band in the same range as 4-chloro-2,5-diphenyloxazole, parent molecule. Introducing of methoxy and nitro substituents shifted the position of maximum absorption and emission spectrum bathochromically.

The highest fluorescent quantum yield was observed for [P1], ϕ_f=0.62.The high concentration of 4-chloro-2,5-diphenyloxazole probably quench the fluorescence resulting a lower quantum yield.

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Output จากโครงการวิจัยที่ได้รับทุนจาก สกว.

1. ผลงานตีพิมพ์ในวารสารวิชาการนานาชาติ

    1 Pimpha, N., Tantayanon, S., Harris, W. F. (2004) " Synthesis and Characterization of a Novel Poly(aryl ether) Containing 4-Chloro-2,5-diphenyloxazole" Molecular Symposia. (accepted)

    2 Pimpha, N., Tantayanon, S., Harris, W. F. (2004) " Direct Synthesis of Phenyl Substituted 4-Chloro-2,5-diphenyloxazoles" Heterocycles. (prepared for submission)

2. การนำผลงานวิจัยไปใช้ประโยชน์

    - เชิงวิชาการ

    โครงการนี้มีส่วนช่วยในการสร้างนักวิจัยใหม่ที่มีความรู้และเชี่ยวชาญด้านการสังเคราะห์พอลิเมอร์และการวิเคราะห์สมบัติทางด้านแสงโดยเฉพาะอย่างยิ่งการนำไปใช้งานด้านซินทิเลเตอร์

    - เชิงพาณิชย์

    โครงการนี้สามารถนำไปประยุกต์ใช้งานได้โดยสามารถแก้ปัญหาที่ 2,5-diphenyloxazole เคลื่อนที่มาที่ผิวของพอลิเมอร์และหลุดออก โดยการสังเคราะห์อนุพันธ์ของ 2,5-diphenyloxazoleที่สามารถเกิดพันธะทางเคมีกับพอลิเมอร์ ทำให้อายุการใช้งานของซินทิเลเตอร์ที่เป็นพอลิเมอร์นานขึ้น

3. การเสนอผลงานในที่ประชุมทางวิชาการ

1. Pimpha, N., Samingprai, S., Tantayanon, S." Effect of Substituents on the Formation of 2,5-Diphenyloxazole derivatives" 27th Congress on Science and Technology of Thailand, October 16-18, 2001, Songkla.
2. Pimpha, N., Harris, W. F., Tantayanon, S." Synthesis and Fluorescence Emission Property of a Novel Fluorescent Polymer" 29th Congress on Science and Technology of Thailand, October 20-22, 2003, Khon Kean.
3. Pimpha, N., Tantayanon, S., Harris, W. F. " Synthesis and Characterization of a Novel Poly(aryl ether) Containing 4-Chloro-2,5-diphenyloxazole" 8th Pacific Polymer Conference, November 24-27, Bangkok.

4. Pimpha, N., Tantayanon, S., Harris, W. F. “ Synthesis, Characterization and Optical Properties of Poly(aryl ether) Containing 4-Chloro-2,5-diphenyloxazole Unit” Macro 2004 40th IUPAC world polymer congress, July 4-9, Paris, France.

APPENDIX A

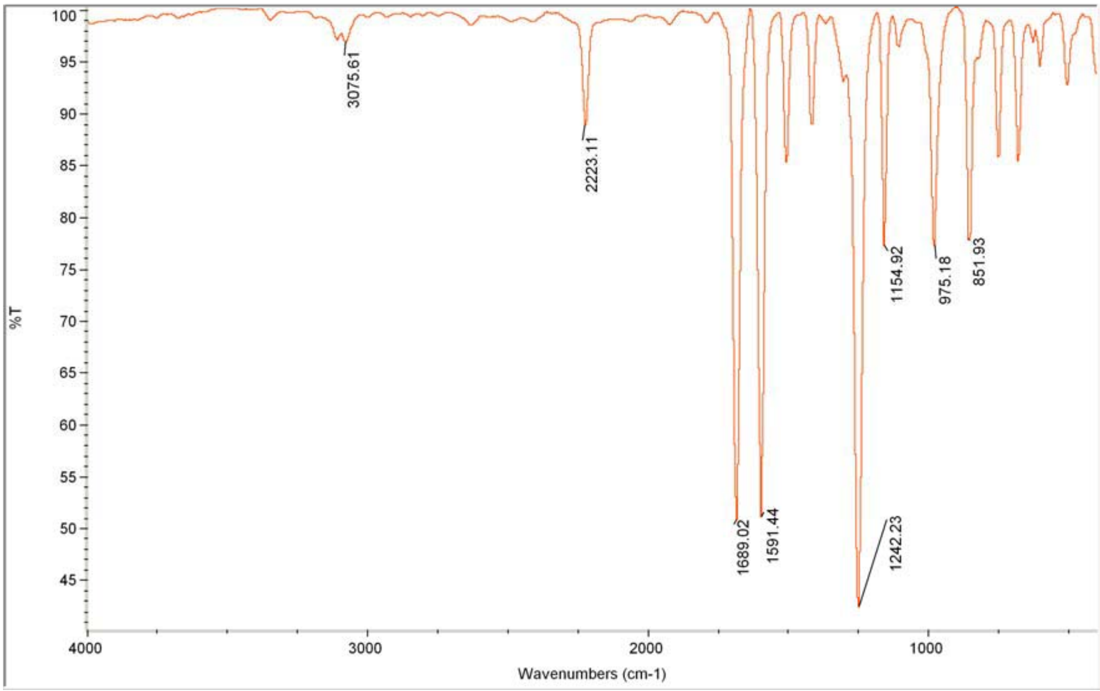

Figure A1 Selected FT-IR spectrum of benzoyl cyanide derivatives

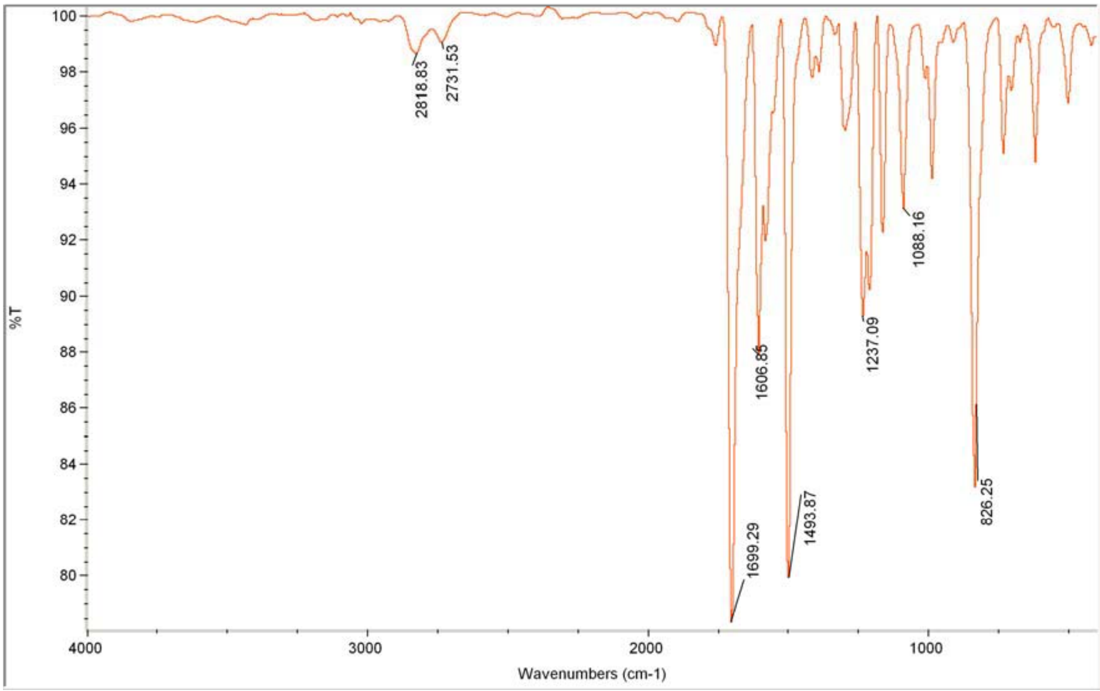

Figure A2 Selected FT-IR spectrum of 4-(4-chloro-5-phenyloxazol-2-yl)-benzaldehyde derivatives

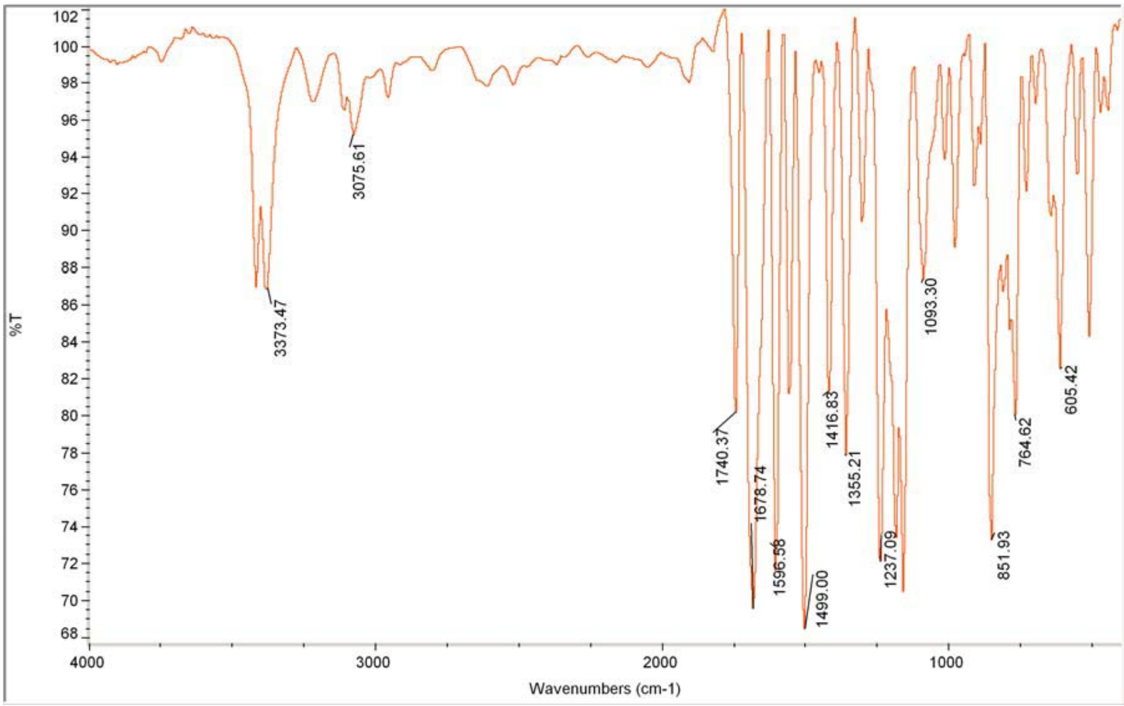

Figure A3 FT-IR spectrum of 4-chloro-2,5-bis(4-fluorophenyl)oxazole

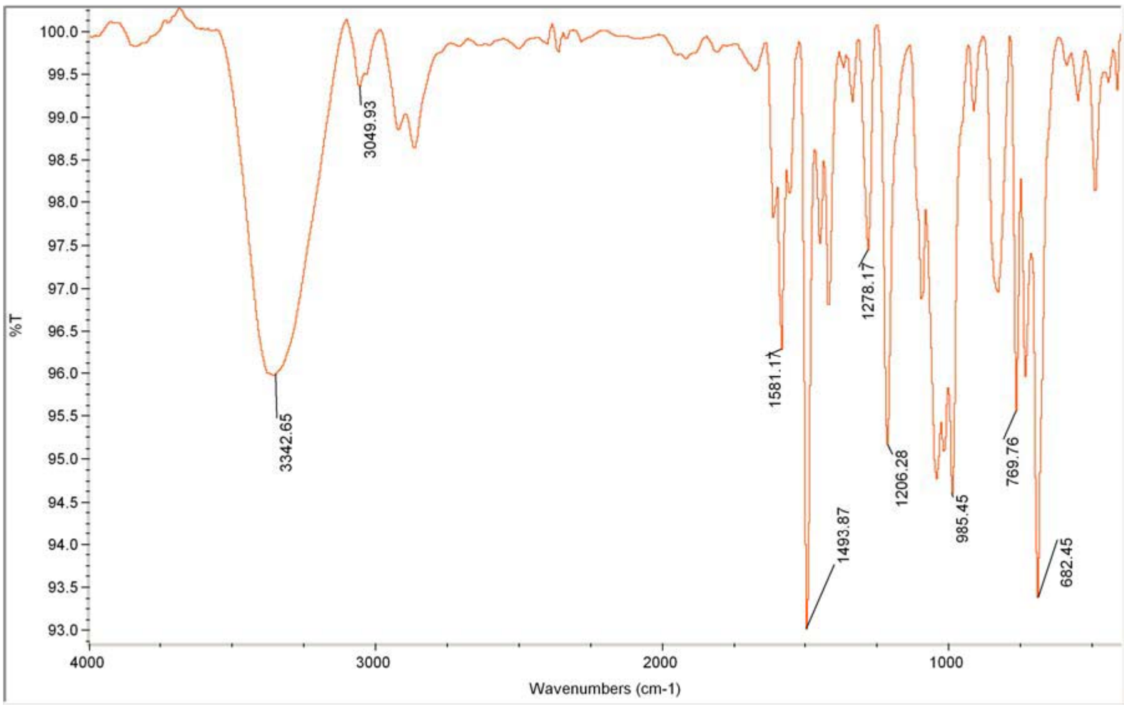

Figure A4 Selected FT-IR spectrum of [4-(4-chloro-5-phenyloxazol-2-yl)-phenyl]-methanol derivatives

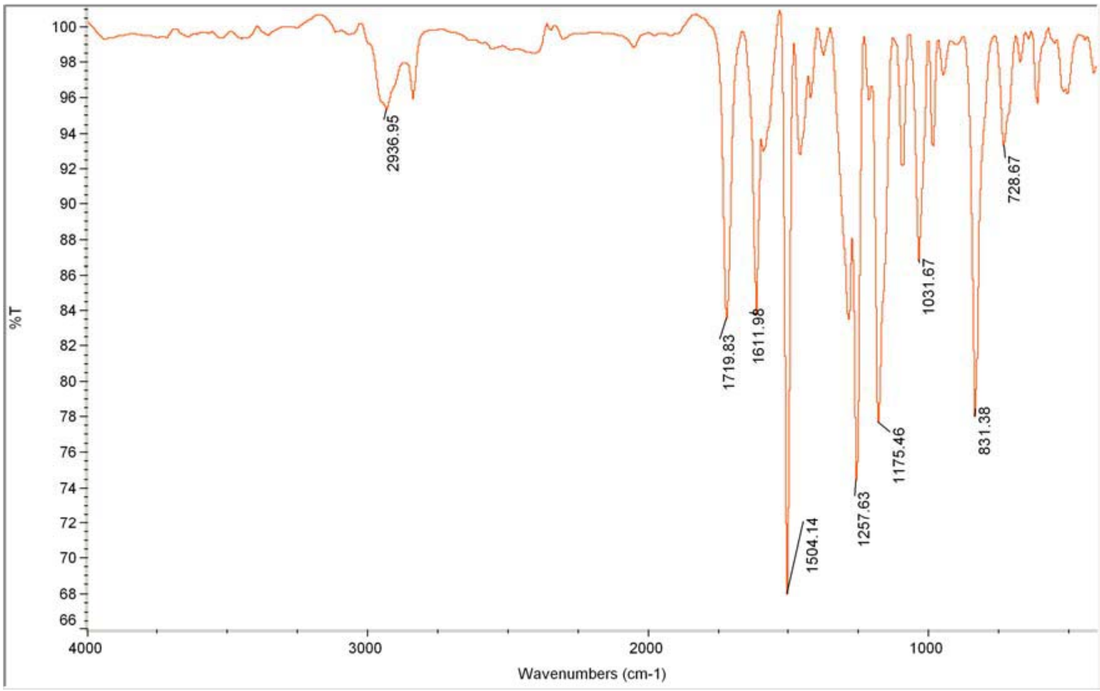

Figure A5 Selected FT-IR spectrum of 2-methylacrylic acid 4-(4-chloro-5-phenyloxazol-2-yl)-benzyl ether derivatives

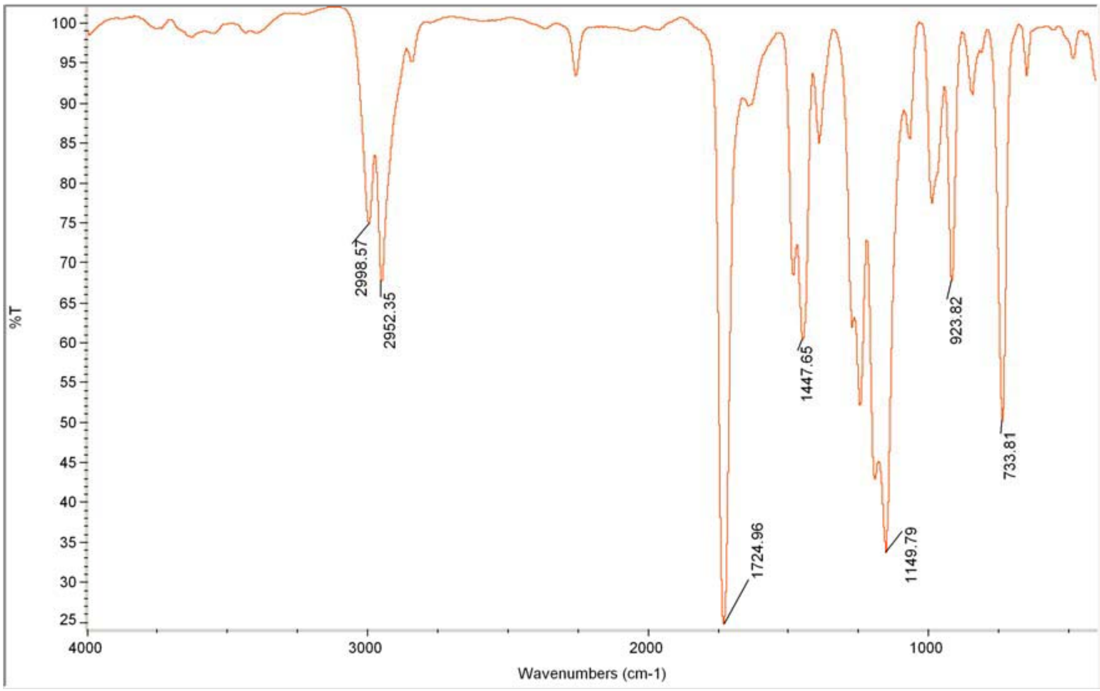

Figure A6 Selected FT-IR spectrum of free radical polymers

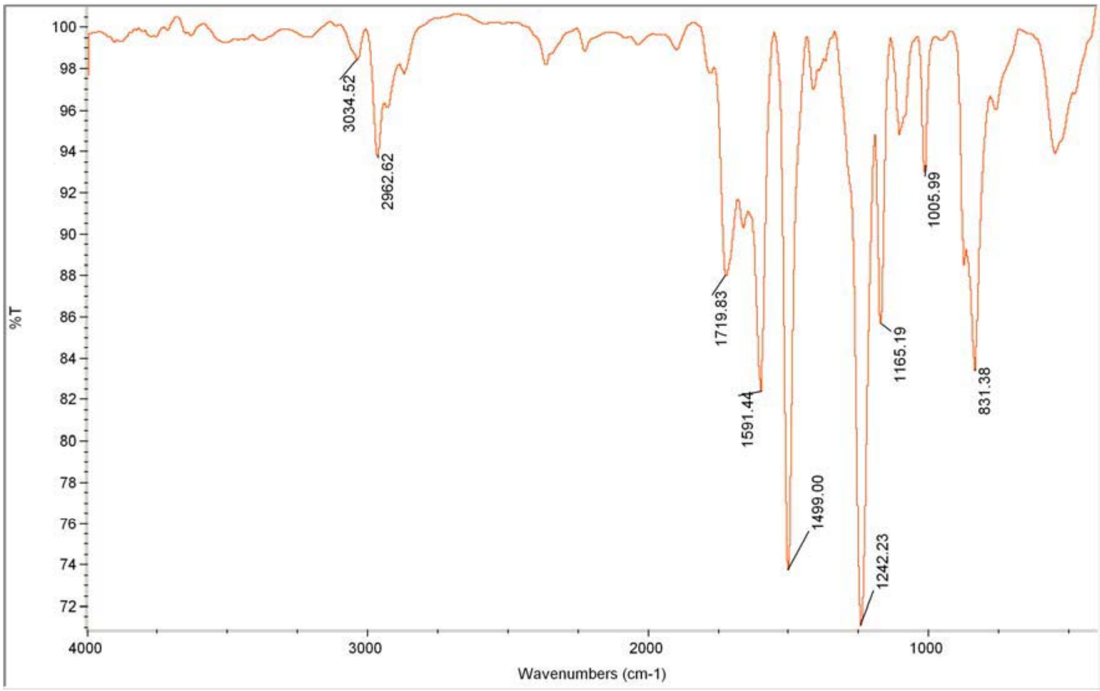

Figure A7 Selected FT-IR spectrum of condensation polymers

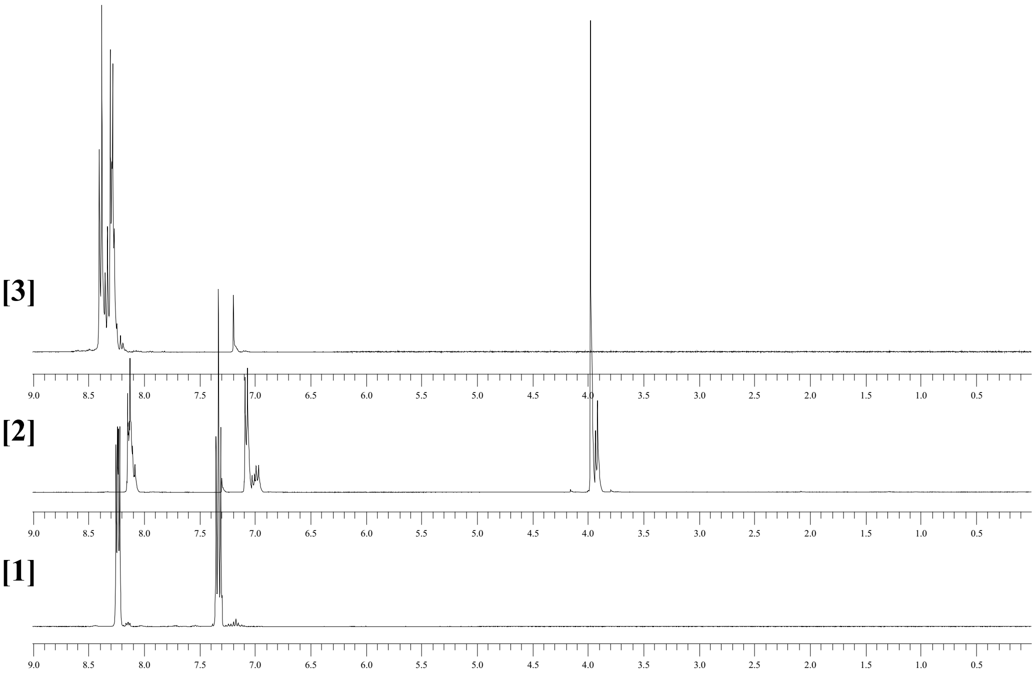

Figure B1: ^{1}H-NMR of benzoyl cyanide derivatives; fluorobenzoyl cyanide **[1]**, 4-methoxybenzoyl cyanide **[2]** and 4-nitrobenzoyl cyanide **[3]**

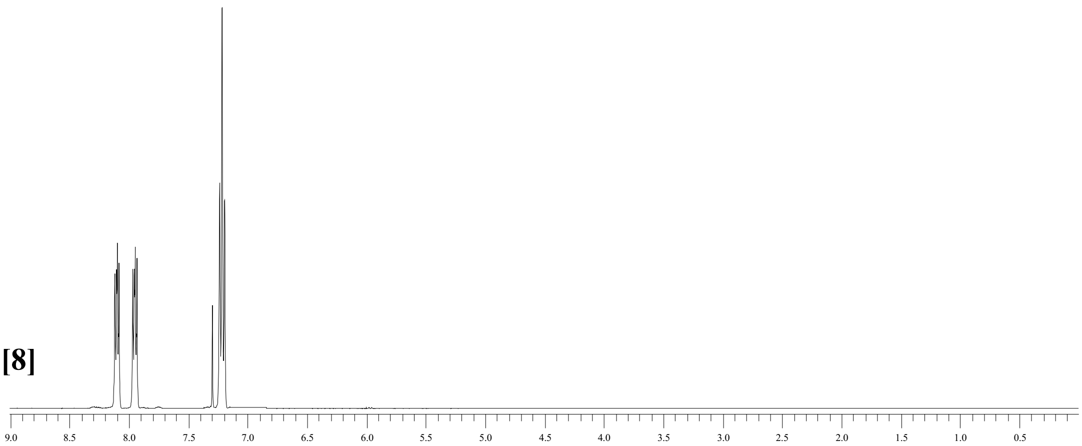

Figure B2: ^{1}H-NMR of 4-chloro-2,5-bis-(4-fluorophenyl)oxazole **[8]**

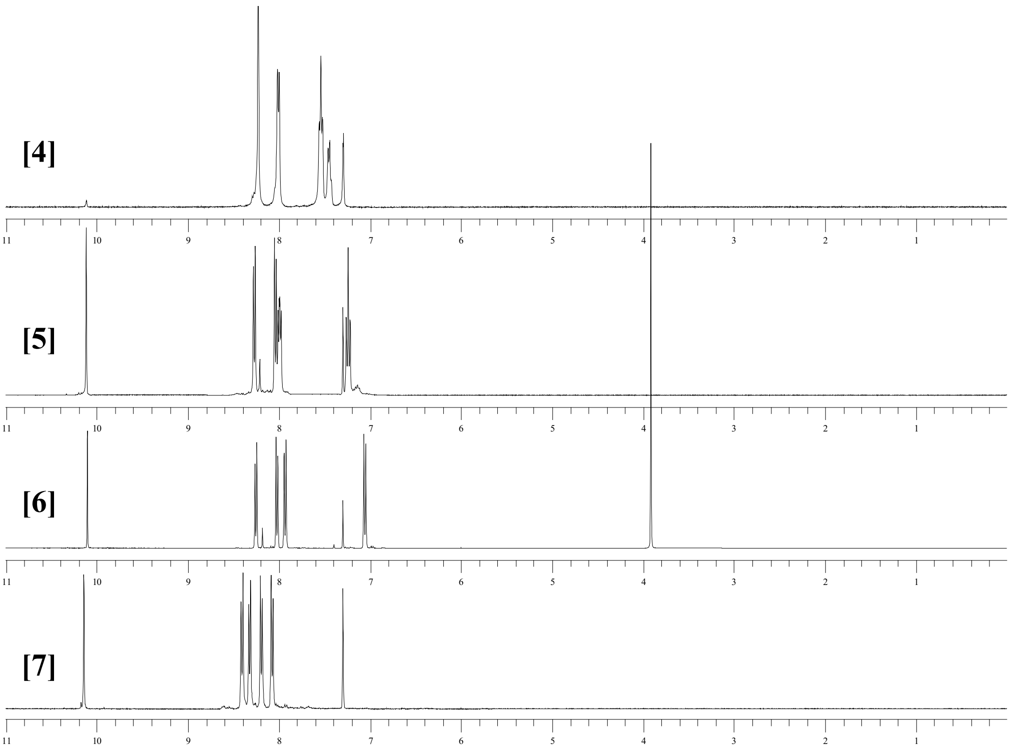

Figure B3: ^{1}H-NMR of 4-(4-chloro-5-phenyl-oxazol-2-yl)-benzaldehyde derivatives

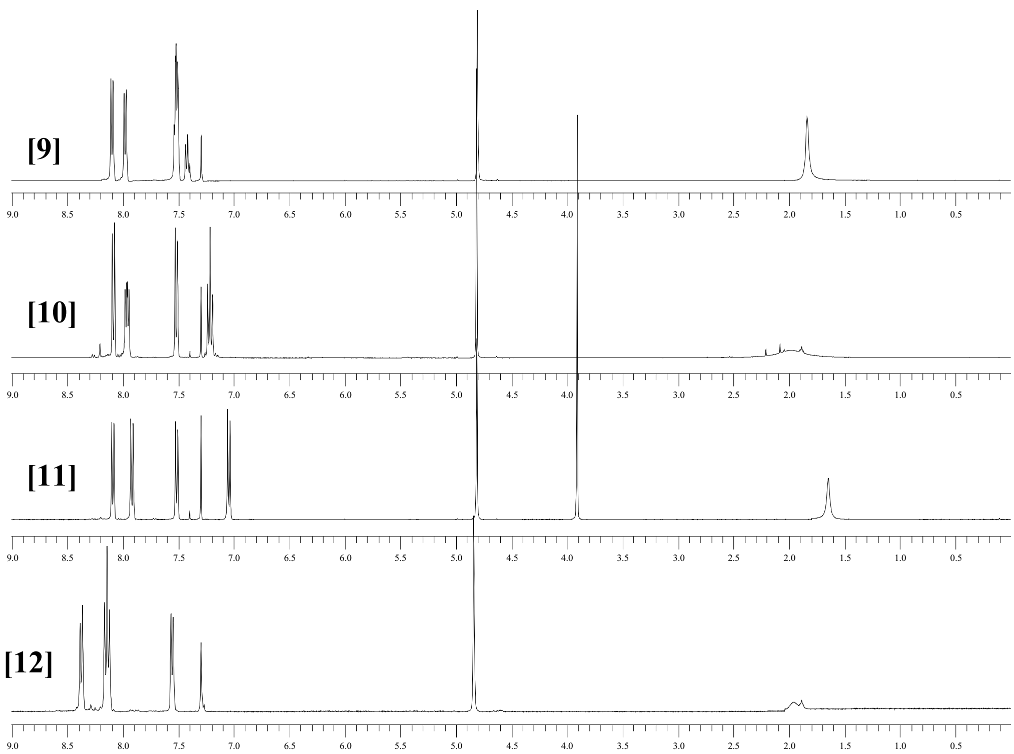

Figure B4: ^{1}H-NMR of [4-(4-chloro-5-phenyl-oxazol-2-yl)-phenyl]-methanol derivatives

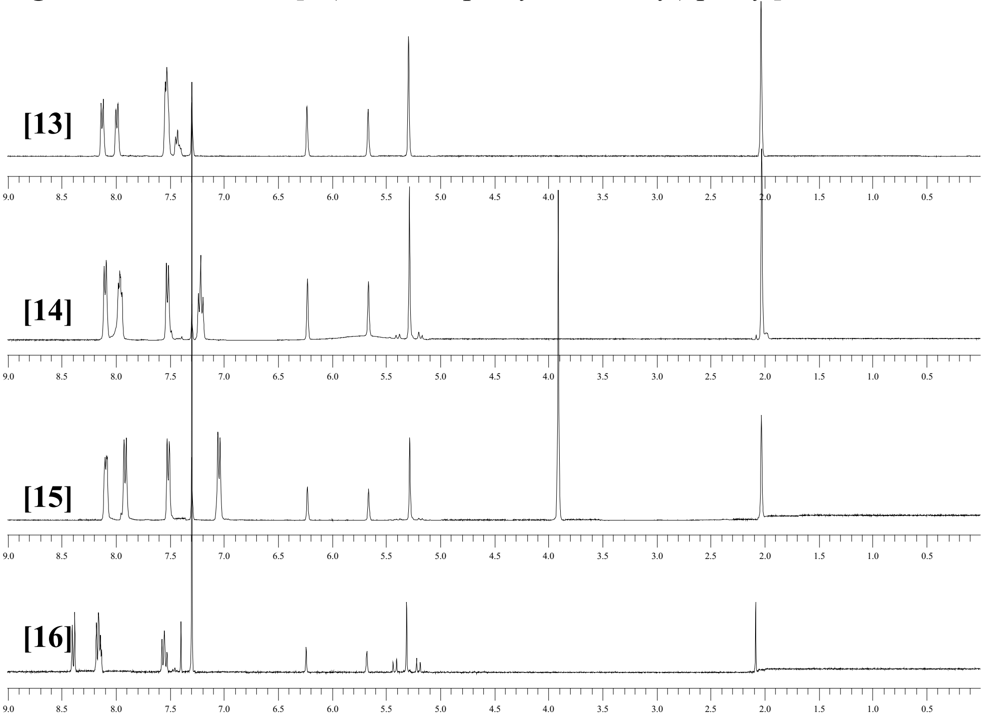

Figure B5: ^{1}H-NMR of 2-methyl-acrylic acid 4-(4-chloro-5-phenyl-oxazol-2-yl)-benzyl ether derivatives

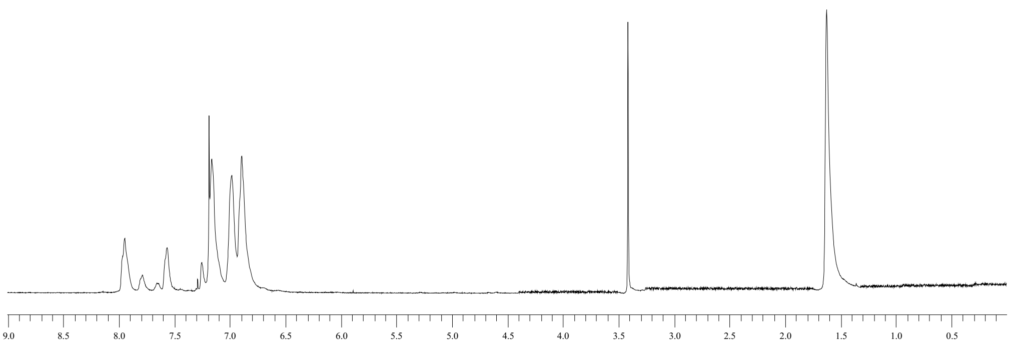

Figure B6: ^{1}H-NMR of condensation polymer

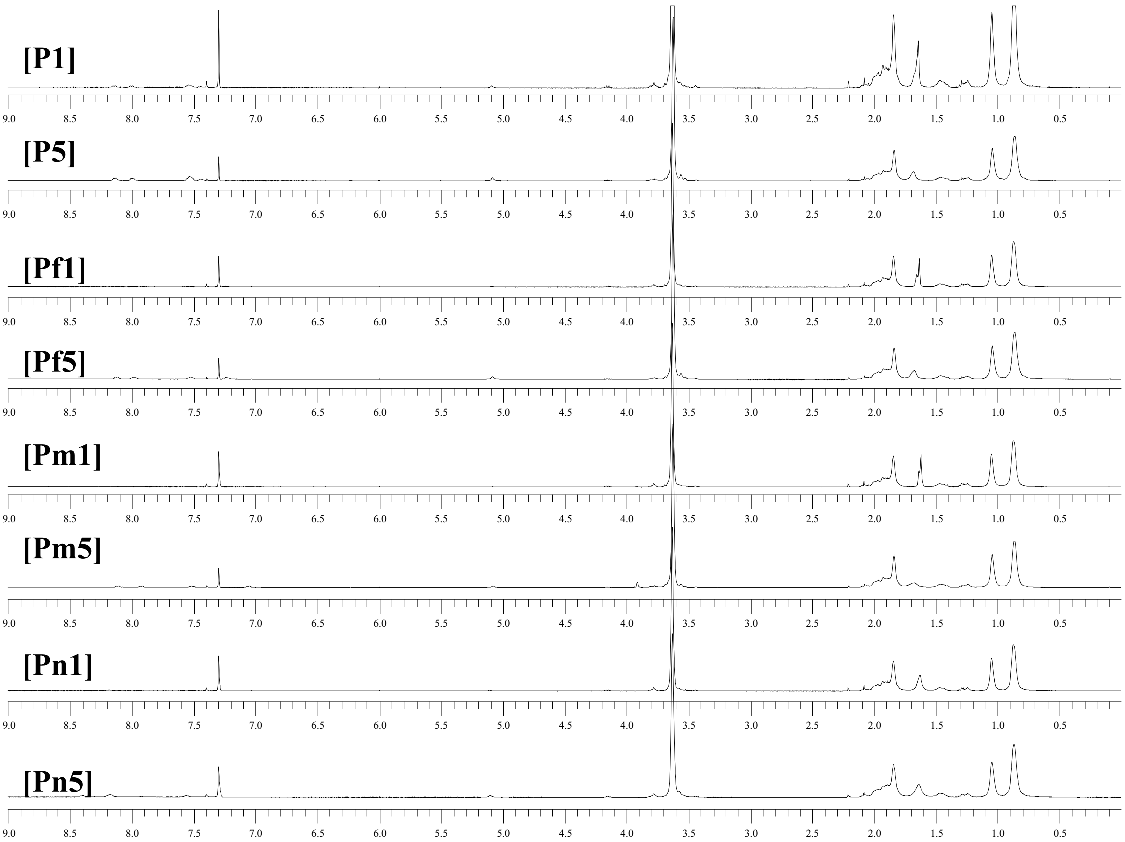

Figure B7: ^{1}H-NMR of free radical polymers

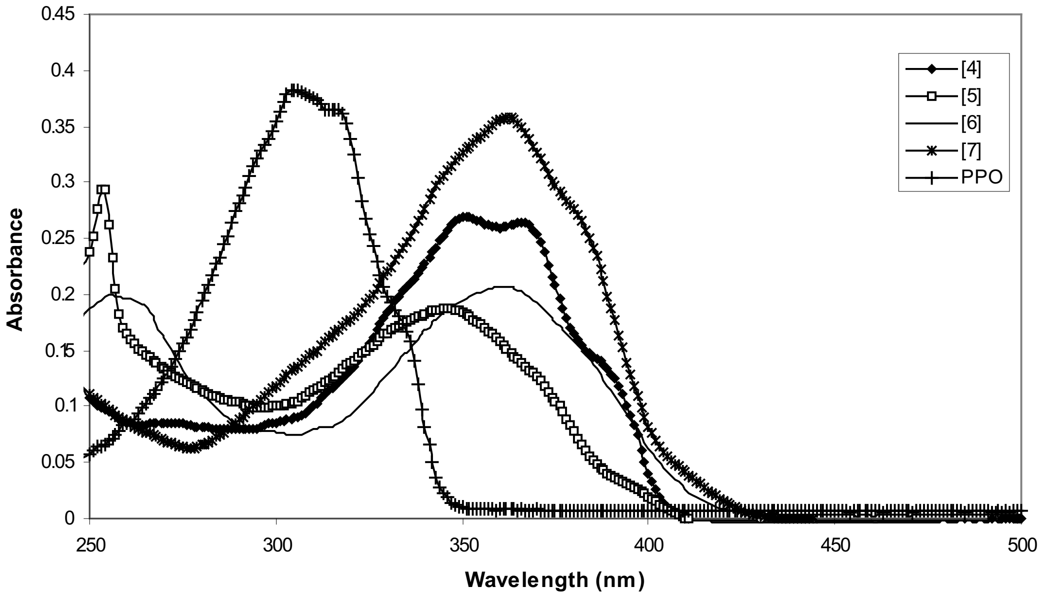

Figure C1: Absorption spectra of compound **[4]-[7]** and **PPO** in THF at the same concentration

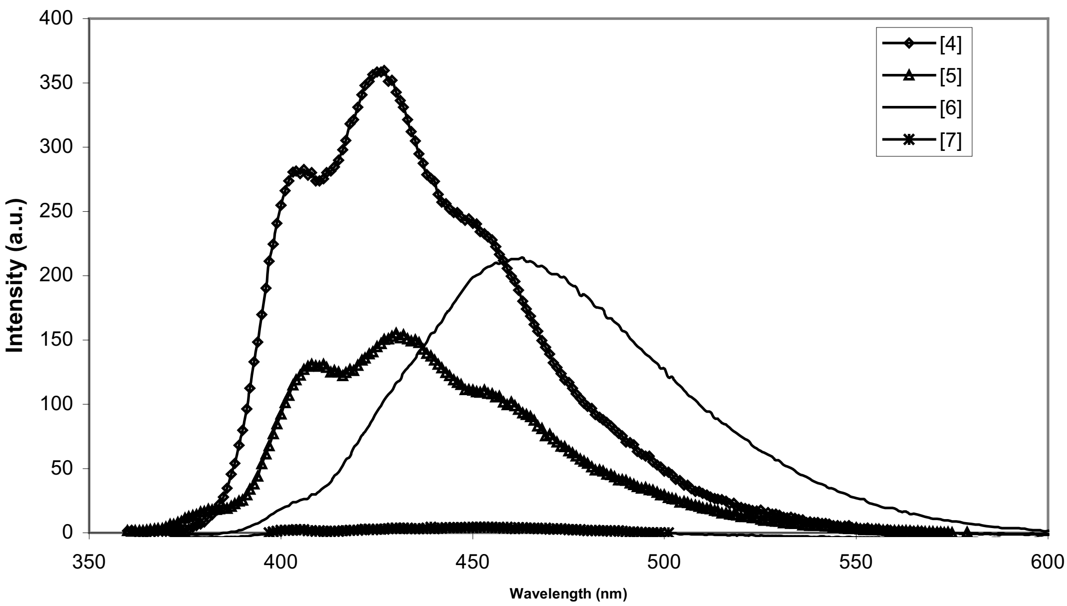

Figure C2: Emission spectra of compound **[4]-[7]** in THF at the same concentration

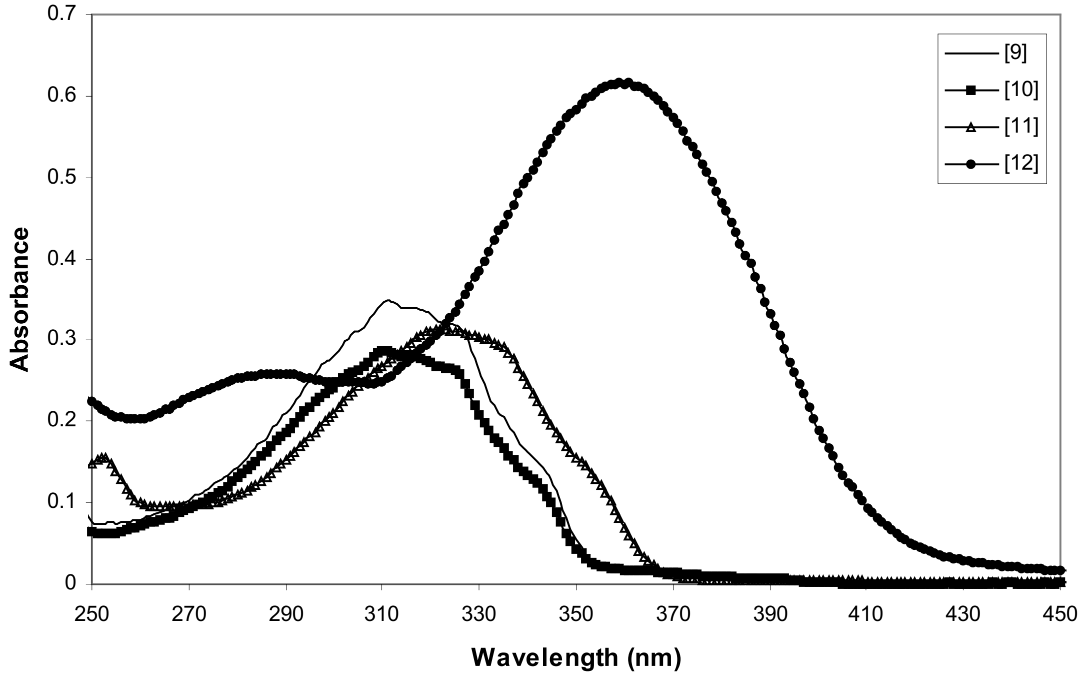

Figure C3: Absorption spectra of compound **[9]-[12]** in THF at the same concentration

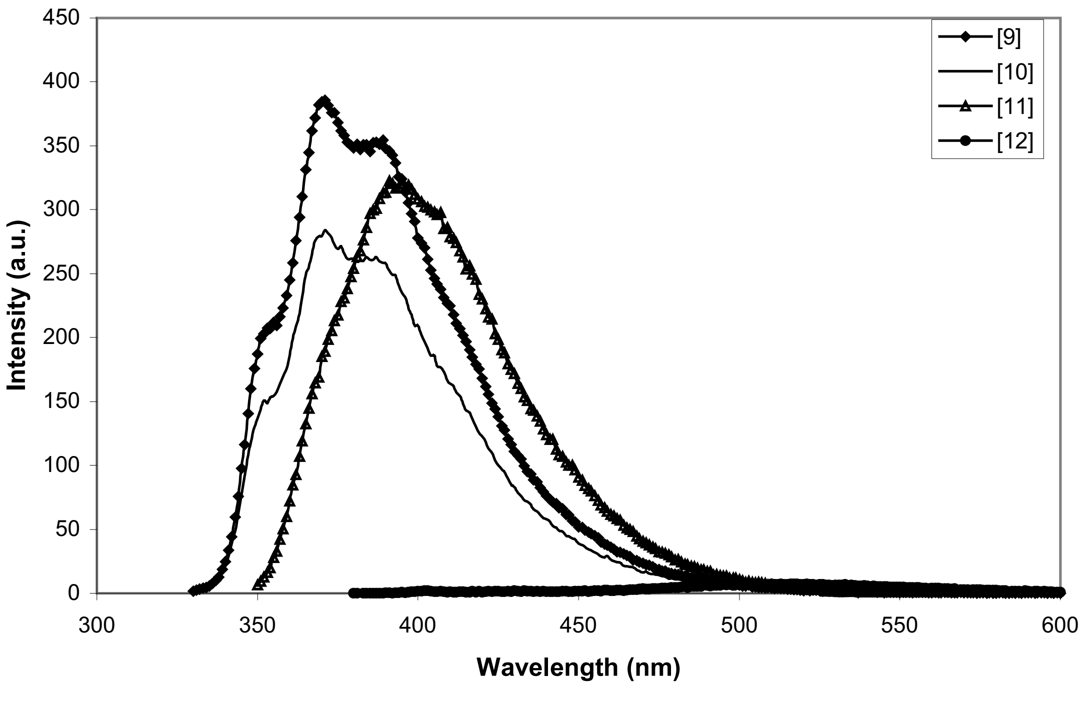

Figure C4: Emission spectra of compound **[9]-[12]** in THF at the same concentration

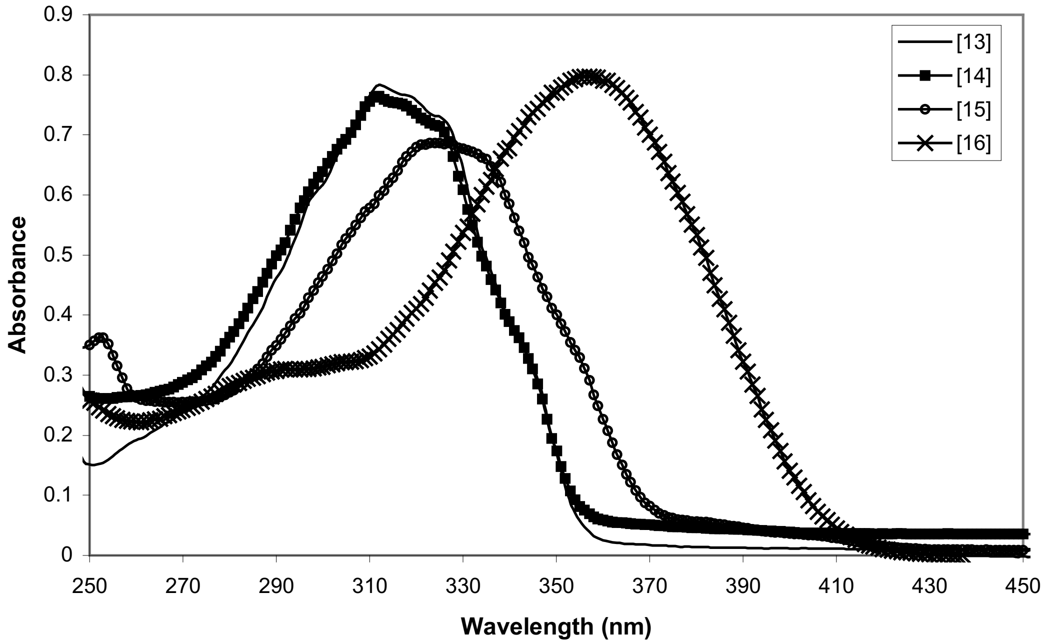

Figure C5: Absorption spectra of compound **[13]-[16]** in THF at the same concentration

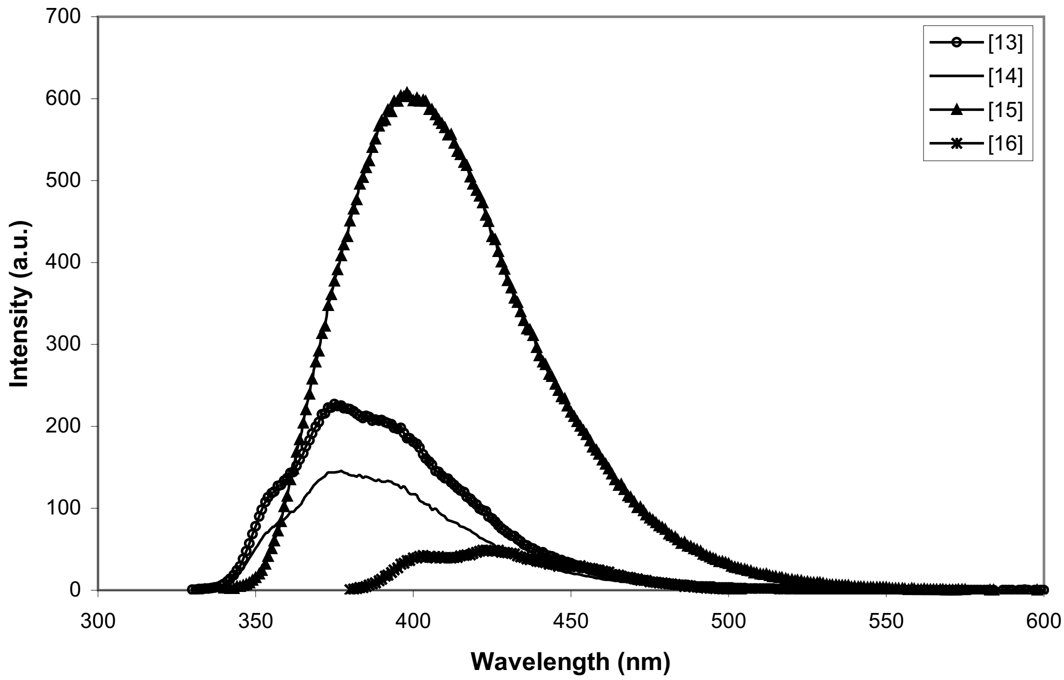

Figure C6: Emission spectra of compound **[13]-[16]** in THF at the same concentration

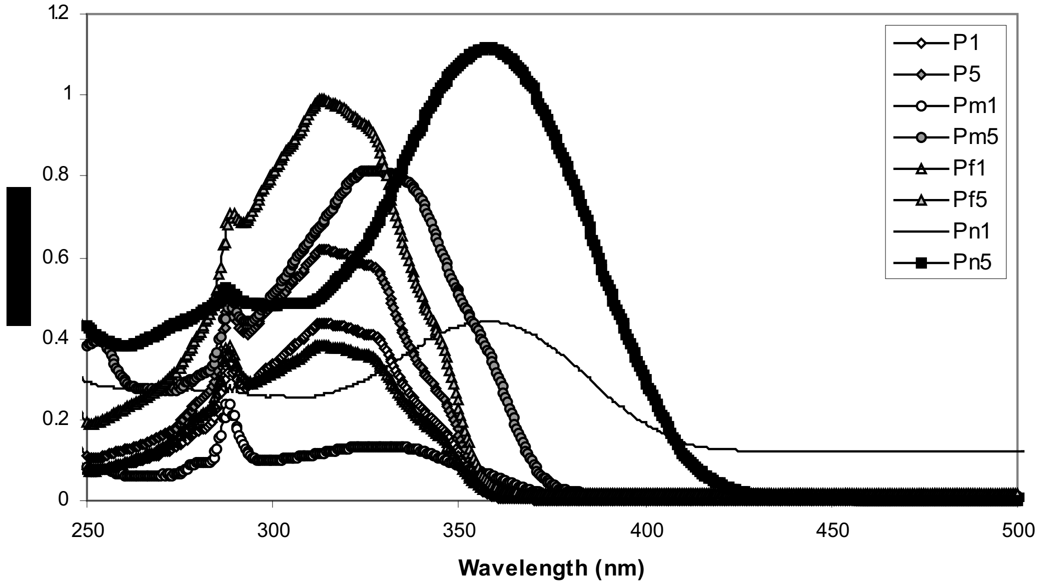

Figure C7: Absorption spectra of **[P1]-[Pn5]** at the same concentration

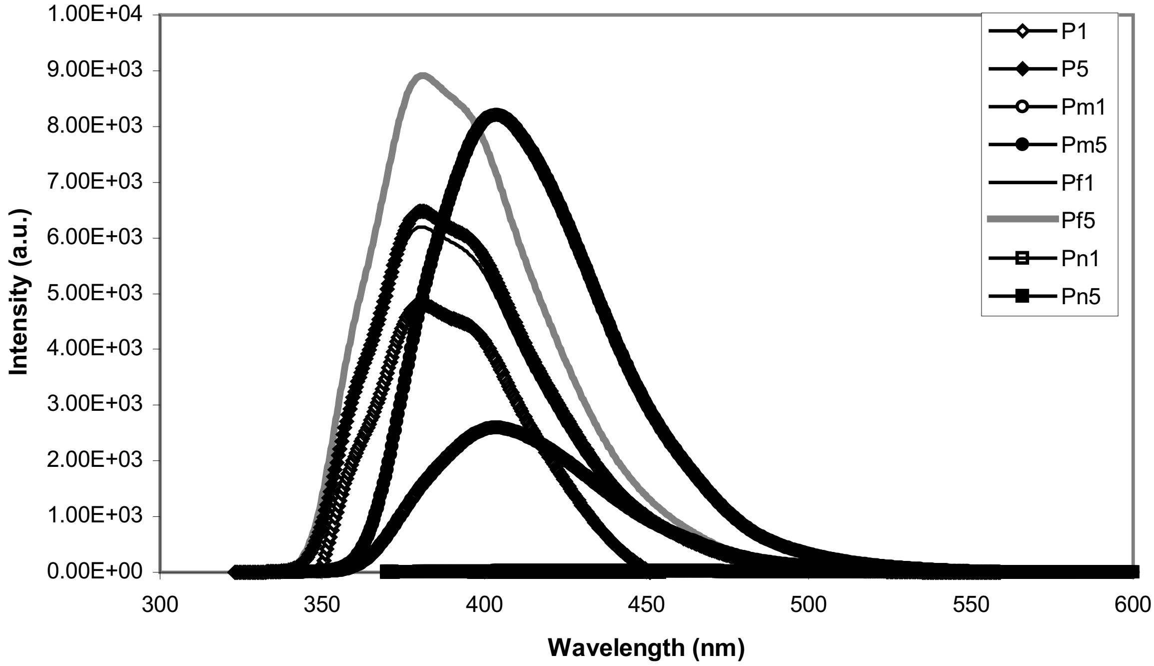

Figure C8:Emission spectra of **[P1]-[Pn5]** at the same concentration

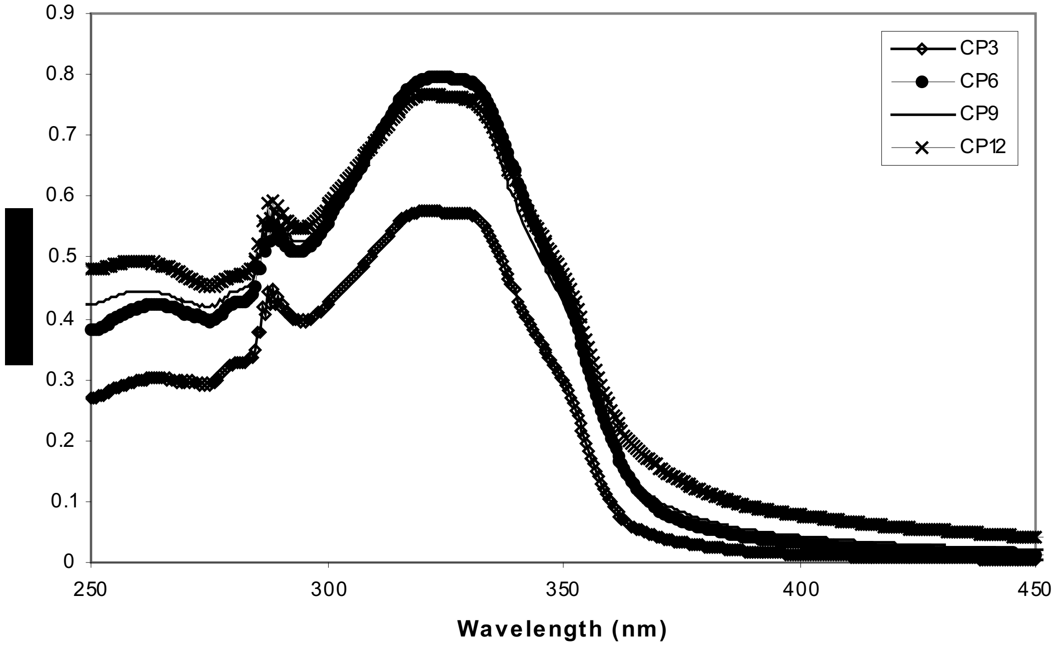

Figure C9: Absorption spectra of **[CP3]-[CP12]** at the same concentration

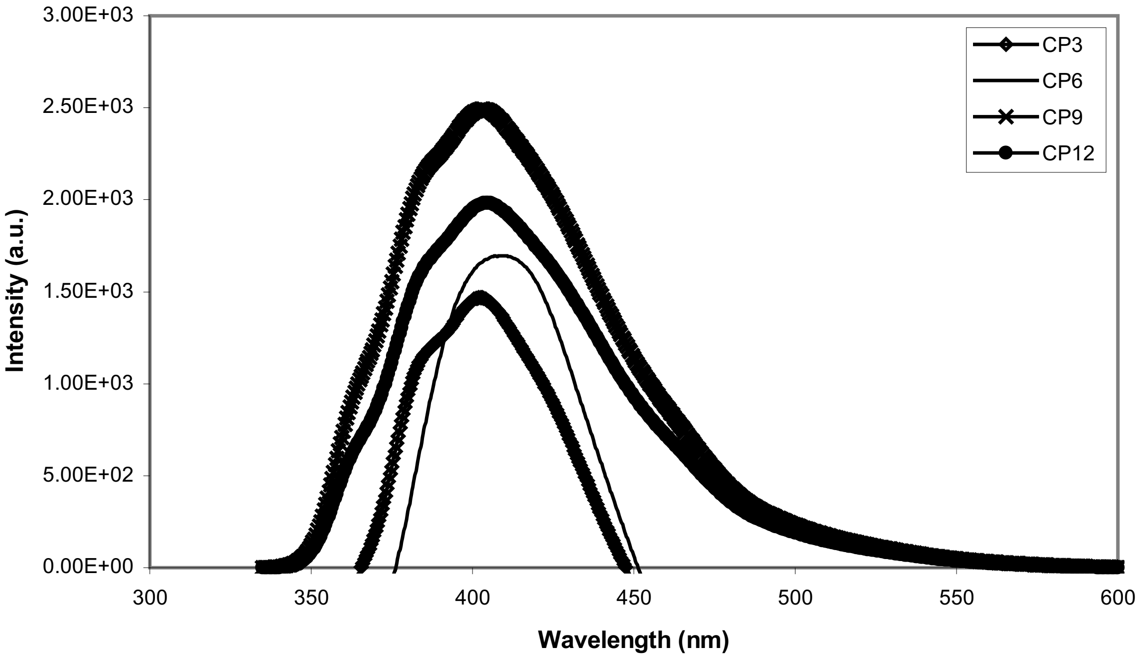

Figure C10: Emission spectra of **[CP3]-[CP12]** at the same concentration

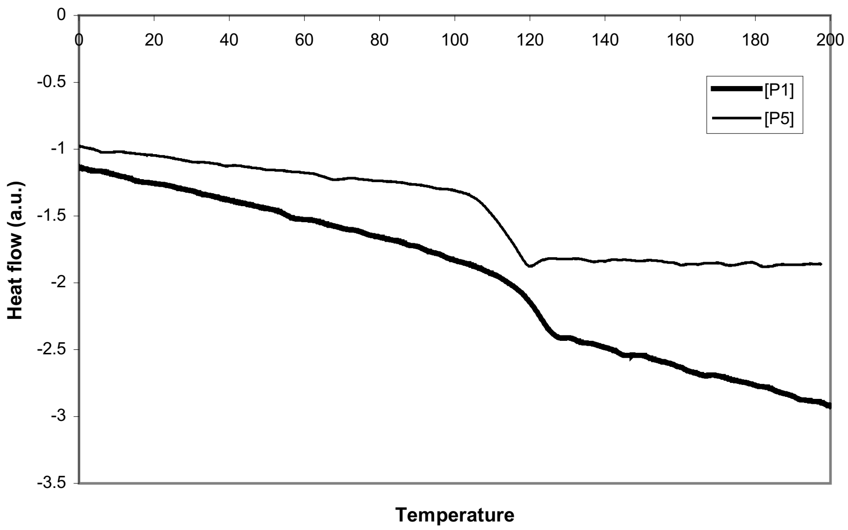

Figure D1: Selected DSC thermogram of free radical polymers

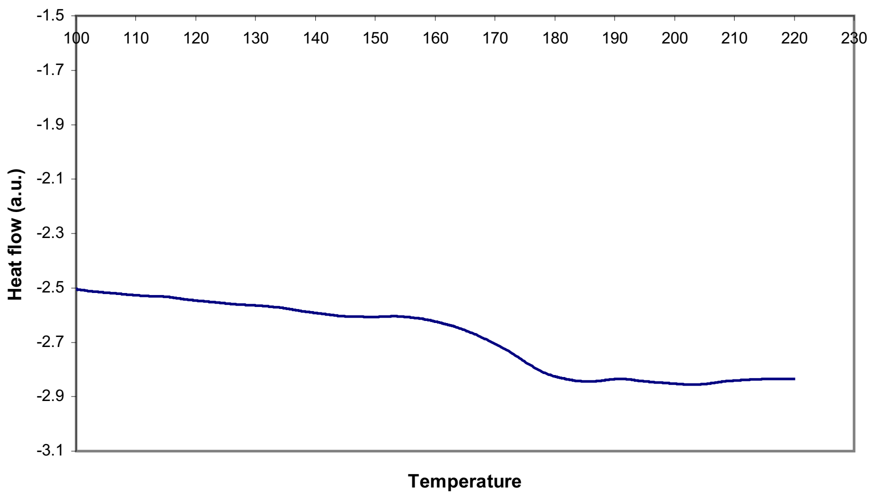

Figure D2: Selected DSC thermogram of condensation polymer