LIST OF FIGURES

Figure		Page
1.1.	Conceptual representation of the process of conventional free-radical polymerisation, where I denotes the initiating species, M, monomer, and the arrows a reaction	3
1.2.	An exponential distribution of chain sizes, as typically obtained from conventional free-radical polymerization carried out over constant conditions, and a Poisson distribution of chain sizes, as obtained from ideal living polymerization.	4
1.3.	Conceptual representation of the process of (ideal) living polymerization, where I denotes the initiating species, M, monomer, and the arrows a reaction	5
1.4.	Typical initiators for (copper-based) ATRP	11
1.5.	A selection of ligands that have been used for copper-based ATRP	13
1.6.	Evolution of the number-average degree of polymerization ($\overline{DP}_n$, broken line) and polydispersity index (PDI, solid line) with fraction conversion of monomer (x) for ideal living polymerisation in which $[M]_0/[I]_0 = 100$	16
1.7.	Classical three-stage concept for the emulsion polymerization process	22
2.1.	Different types of interactions can occur between an electronbeam and a specimen.	51
2.2.	Geometry of SEM	54
2.3.	Transmission electron microscope with all of its components	56
2.4.	Polymer molecular weight versus retention volume in three chromatographic separation modes: size exclusion chromatography (SEC), liquid chromatography at critical condition (LCCC) and interaction chromatography (IC)	60
2.5.	Vacuum line	65
2.6.	Apparatus for monomer distillation	68

2.7. Appartus for monomer dilution 69

2.8. Titration apparatus (A, B: cutting point, C: main reactor, D: n-octyl alcholol E: initiator, F: washing solution, G: receiver for washing solution) 70

2.9. Apparatus for polymerization (A, B: cutting point, C: main reactor, D: receiver for washing solution, E: initiator, F: washing solution G: monomer, H: ligand 72

3.1. GPC chromatograms of (Br-PS-Br) macroinitiator, BAB1, and CBABC tri- and pentablock copolymers 84

3.2. Evolution of molecular weight, (M_n) and molecular weight distribution, (M_w/M_n) with monomer conversion for the ATRP of n-butyl methacrylate (BAB2) 86

3.3. Evolution of the GPC chromatograms with conversion and time for the ATRP of n-butyl methacrylate (BAB2) 87

3.4. (a) ^{1}H NMR of BAB1, triblock and (b) CBABC pentablock copolymers 87

3.5. (a) TGA of BAB1, triblock and CBABC pentablock copolymer (b) DSC of BAB1 and CBABC block copolymers 89

3.6. TEM micrographs in toluene (3mg/ml) (a) BAB1 triblock copolymer (b) CBABC pentablock copolymer(c) and (d) Inverse Fast Fourier Transform (IFFT) images of the selected area (marked by arrows) showing clearly the phase separation between the two phases. 91

4.1. ^{1}H NMR spectra of HEBI in $CDCl_3$ 101

4.2. SEC traces of MMA polymerization in emulsion by varying time interval for monomer addition(EP1; one shot), (EP2; 120 min) and (EP3;60 min) 106

4.3. SEC traces of MMA polymerization in emulsion showing the increase in molecular weight as a function of time for EP5 107

4.4. Scaning electron microscopy (SEM) images monodisperse Poly(methyl methacrylate) produced by emulsion ATRP using mixed

ligand system at room temperature for (A)EP3,(B) EP2 and (C) EP5 108

4.5. (A)1H NMR spectrum of the sample EP5 in $CDCl_3$ and (B) FT-IR spectrum of EP5 109

5.1. ^{1}H NMR spectra of MTEE in $CDCl_3$ 117

5.2. SEC chromatograms for (a) PSt (**1**) and (b) P2VP (**2**) showing the Evolution of molecular weight with time 124

5.3. SEC chromatograms for PS, P2VP macropromoters and PS-*b*-P2VP, (**3**) P2VP-*b*-PS (**4**) block copolymers showing the evolution of molecular weight with time 126

5.4. ^{1}H NMR spectrum of PS-*b*-P2VP (**3a** and **3b**) and P2VP-*b*-PS (**4**) in $CDCl_3$ 128

5.5. FT-IR spectra of the parent P2VP-*b*-PS and quaternized Q-P2VP-*b*-PS 129

5.6. TEM images of Q-PS-*b*-P2VP nanoparticles: (a) without TiO_2 (b) with TiO_2, also accompanied by the corresponding HRTEM image and histogram showing the lattice spacing of 0.377 nm acquired from this sample 131

5.7. SEM images of nanoporous titania layer prepared by removing template of Q-PS-b-P2VP nanoparticles: (a) surface (b) 30° tilted cross-section nanoporous titania layers prepared by sintering at 600 °C for 4 hrs (c) surface view of nanoporous titania layers prepared by sintering at 600 °C for 4 hrs, and (d) Surface view of nanoporous titania layers prepared by oxygen plasma etching for 5 min 132

5.8. Energy-dispersive X-Ray (EDX) spectra of as synthesized nanoporous titania layer prepared by removing template of Q- P2VP-*b*-PS nanoparticles after sintering 133

6.1. (a) Size-exclusion chromatography (SEC) curves of three sets of polymers obtained from C1 to C3. (b) Temperature gradient interaction chromatography (TGIC) curves of the various block copolymers, F1–F4 showing the fractionation (dotted lines) of C3. (c) SEC curves of four TGIC fractions (F1–F4) after fractionation of C3 146