

Table of Contents

1. INTRODUCTION.....	1
1.1 Biomedical applications of polymers	1
1.1.1 Drug delivery systems	1
1.1.2 Tissue engineering.....	4
1.2 Sources of polymers for biomedical applications	5
1.2.1 Natural polymers.....	6
1.2.2 Synthetic polymers.....	6
1.3 Nano- to macro-scale polymeric materials for biomedical applications	8
1.3.1 Polymeric micelles.....	8
1.3.2 Nanogels.....	10
1.3.3 Microgels	11
1.3.4 Hydrogels.....	12
2 OBJECTIVES.....	15
3 MATERIALS and METHODS.....	17
3.1 Materials.....	17
3.2 π - π stacked polymeric micelles	17
3.2.1 Synthesis of mPEG-b-p(OPMAm-HBz) and mPEG-b-p(HPMAm-HBz)	17
3.2.2 Preparation of micelles	18
3.2.3 pH-dependent degradation of micelles	19
3.2.4 Drug release from polymeric micelles.....	19
3.2.5 Micelle cytotoxicity	20
3.2.6 Pharmacokinetics and biodistribution of micelles.....	21
3.3 Nanogels.....	22
3.3.1 Synthesis of p(OPMA).....	22
3.3.2 Preparation of nanogels.....	22
3.3.3 Kinetics of nanogels formation in water	24
3.3.4 Kinetics of nanogel formation in DMSO.....	24

3.3.5 Förster resonance energy transfer (FRET) analysis.....	25
3.3.6 Hydrophobic interaction analysis.....	26
3.3.7 Drug loading in nanogels.....	26
3.4 Microgels	27
3.4.1 Formation of microgels	27
3.4.2 Modification of microgels	28
3.4.3 Cytotoxicity of microgels.....	28
3.5 Macroscale hydrogels.....	29
3.5.1 Preparation and mechanical characterization of hydrogels	29
3.5.2 Physicochemical characterization of hydrogels	29
3.5.3 Cytotoxicity of hydrogels.....	30
3.6 Statistical analysis.....	31
4 RESULTS	33
4.1 π - π stacked polymeric micelles	33
4.1.1 Synthesis of mPEG-p(HPMAm-Bz) and mPEG-p(OPMAm-HBz)	33
4.1.2 Drug loading in π - π stacked polymeric micelles	34
4.1.3 pH-dependent degradation of π - π stacked polymeric micelles.....	35
4.1.4 Drug release from micelles	37
4.1.5 Cytotoxicity of drug-loaded polymeric micelles.....	38
4.1.6 Pharmacokinetics and biodistribution of micelles.....	39
4.2 Nanogels.....	41
4.2.1 Polymerization of OPMA by RAFT and free radical methods	41
4.2.2 Solubilization of polymers from RAFT and free radical polymerization	42
4.2.3 RAFT polymerization of OPMA.....	43
4.2.4 Kinetics of OPMA polymerization	44
4.2.5 Formation of p(OPMA) nanogels	45
4.2.6 Kinetics of nanogel formation.....	54
4.2.7 Stability of nanogels.....	56
4.2.8 Drug loading in nanogels.....	57

4.3	Microgels	58
4.3.1	Formation of microgels	58
4.3.2	3D printing based on microgel-based fibers	60
4.3.3	Biocompatibility of p(OPMA) microgels	60
4.3.4	Cell adhesion to p(OPMA) microgels	61
4.4	Macroscale hydrogels	62
4.4.1	Preparation of hydrogels	62
4.4.2	Stiffness of hydrogels	64
4.4.3	Cytotoxicity of hydrogels	66
5	DISCUSSION	67
5.1	Tumor-targeted drug delivery via nanoparticles	67
5.1.1	Tumor microenvironment-responsive polymeric nanoparticles	68
5.1.2	Ultrasmall polymeric nanogels	69
5.2	Injectable hydrogels for local drug delivery	70
5.3	Microgels for tissue engineering	72
5.4	Future perspectives	73
6	SUMMARY:	75
7	ZUSAMMENFASSUNG:	76
8	REFERENCES	77
9	APPENDIX	92
9.1	List of publications	92
9.2	Acknowledgments	93
9.3	Erklärung zur Datenaufbewahrung	95
9.4	Erklärung über den Eigenanteil	96
9.5	Curriculum vitae	97