



# Contents

<b>1</b>	<b>Introduction</b> .....	<b>5</b>
<b>2</b>	<b>Problem statements</b> .....	<b>7</b>
<b>3</b>	<b>Objective</b> .....	<b>9</b>
<b>4</b>	<b>Literature Review</b> .....	<b>12</b>
<b>4.1</b>	<b>Preceramic Polymers</b> .....	<b>12</b>
4.1.1	History of Preceramic Polymers .....	12
4.1.2	Synthesis of polysilazanes for precursor derived ceramics (PDCs) .....	13
4.1.3	Copolymerization to polyorganosilazanes .....	16
4.1.4	Cross-linking of oligosilazanes to modified polysilazanes .....	19
4.1.5	Conversion behaviour of polymer derived ceramics (PDCs).....	24
<b>4.2</b>	<b>Non-oxide ceramic fibres</b> .....	<b>27</b>
4.2.1	Processing, structure and properties of non-oxide ceramic fibres.....	27
4.2.2	CVD derived SiC fibres .....	27
4.2.3	Polymer derived fibres.....	31
4.2.3.1	<i>Ceramic fibres based on SiC systems</i> .....	31
4.2.3.2	<i>Ceramic fibres based on SiCN systems</i> .....	43
<b>5</b>	<b>Experimental Procedure</b> .....	<b>49</b>
<b>5.1</b>	<b>Chemicals used for the synthesis of polysilazanes</b> .....	<b>49</b>
<b>5.2</b>	<b>Selective chemical cross-linking of liquid oligosilazanes to tailored melttable polysilazanes</b> .....	<b>50</b>
<b>5.3</b>	<b>Polymer characterization</b> .....	<b>51</b>
5.3.1	Chemical Analysis .....	51
5.3.2	Thermal Analysis.....	53
5.3.3	Rheology .....	54
<b>5.4</b>	<b>Curing of polymers with electron beam irradiation</b> .....	<b>59</b>
<b>5.5</b>	<b>Processing of green (polymer) fibres</b> .....	<b>60</b>
<b>5.6</b>	<b>Curing and pyrolysis of green (polymer) fibres</b> .....	<b>61</b>
<b>5.7</b>	<b>Mechanical and thermal properties of fibres</b> .....	<b>63</b>
5.7.1	Tensile test of single fibres at room temperature .....	63



5.7.2	Statistical analysis of fibre tensile strength .....	64
5.7.3	BSR-Test .....	65
5.7.4	Oxidation behaviour of ceramic SiCN fibres .....	66
<b>6</b>	<b>Results and Discussion .....</b>	<b>67</b>
6.1	Tailored meltable polysilazanes.....	67
6.2	Thermal stability and viscoelasticity of polysilazanes .....	74
6.2.1	Thermal properties .....	74
6.2.2	Rheological properties.....	79
6.3	Curing behaviour of polysilazanes irradiated with electron beam .....	94
6.4	Melt spinning process of green (polymer) fibres .....	99
6.5	Mechanical stability of cured green (polymer) fibres.....	102
6.6	Pyrolysis of cured green (polymer) fibres .....	105
6.7	Mechanical and Thermal Properties of ceramic SiCN fibres .....	108
6.7.1	Tensile strength at room temperature.....	109
6.7.2	Creep resistance .....	115
6.7.3	Oxidation behaviour of ceramic SiCN fibres .....	120
<b>7</b>	<b>Conclusions .....</b>	<b>125</b>
<b>8</b>	<b>Zusammenfassung .....</b>	<b>129</b>
<b>9</b>	<b>List of abbreviations and symbols.....</b>	<b>133</b>
<b>10</b>	<b>References .....</b>	<b>136</b>
	<b>Publications .....</b>	<b>156</b>
	<b>Acknowledgments .....</b>	<b>157</b>
	<b>Curriculum Vitae .....</b>	<b>159</b>