

## LIST OF FIGURES

	Page No.
<b>Figure 1.1</b> - Wear - time curve	8
<b>Figure 1.2</b> - Friction - time curve	15
<b>Figure 1.3</b> - Different types of reinforcements	.22
<b>Figure 1.4</b> - Stir casting technique	.32
<b>Figure 1.5</b> - Squeeze casting technique	.33
<b>Figure 1.6</b> - Comparison cost	.34
<b>Figure 2.1</b> - Schematic diagram of experimental setup used for casting	.47
<b>Figure 2.2</b> - Flow chart for synthesizing the composites	48
<b>Figure 2.3</b> - DTA/TGA apparatus for DTA analysis	.49
<b>Figure 2.4</b> - XRD Machine	.49
<b>Figure 2.5</b> - Optical Microscope	.52
<b>Figure 2.6</b> - Scanning Electron Microscope	53
<b>Figure 2.7</b> - <b>a</b> - Transmission Electron Microscope and <b>b</b> - Twin jet polisher	.54
<b>Figure 2.8</b> - Brinell hardness tester	.54
<b>Figure 2.9</b> - <b>a</b> - Universal Testing Machine and <b>b</b> - Geometry of tensile test specimen	55
<b>Figure 2.10</b> - Multifunctional Tribometer	.56
<b>Figure 2.11</b> - Schematic diagram for pin-on-disc apparatus	.57
<b>Figure 2.12</b> - Profilometer attached to Multifunctional Tribometer	.58
<b>Figure 2.13</b> - High temperature chamber, disc and sample holder	.58
<b>Figure 3.1</b> - DTA curve showing the endothermic and exothermic peak during <i>insitu</i> reaction	.60
<b>Figure 3.2</b> - XRD patterns of (a) AA5052/ZrB <sub>2</sub> composites and (b) extracted ZrB <sub>2</sub> particle for 9 vol. % composite	62
<b>Figure 3.3</b> - Optical micrographs of (a) AA5052 - 0 vol. % ZrB <sub>2</sub> (b) AA5052 - 3 vol. % ZrB <sub>2</sub> (c) AA5052 - 6 vol. % ZrB <sub>2</sub> (d) AA5052 - 9 vol. % ZrB <sub>2</sub> and (e) AA5052 - 10 vol. % ZrB <sub>2</sub>	.64
<b>Figure 3.4</b> - Grain size distribution of (a) AA5052 - 0 vol. % ZrB <sub>2</sub> (b) AA5052 - 3 vol. % ZrB <sub>2</sub> (c) AA5052 - 6 vol. % ZrB <sub>2</sub> (d) AA5052 - 9 vol. % ZrB <sub>2</sub> and (e) AA5052 - 10 vol. % ZrB <sub>2</sub>	65
<b>Figure 3.5</b> - SEM micrographs of (a) AA5052 - 3 vol. % ZrB <sub>2</sub> (b) AA5052 - 6 vol. % ZrB <sub>2</sub> (c) AA5052 - 9 vol. % ZrB <sub>2</sub> (d) AA5052 - 10 vol. % ZrB <sub>2</sub> (e) ZrB <sub>2</sub> at high magnification and (f) EDS pattern of ZrB <sub>2</sub>	68
<b>Figure 3.6</b> - TEM micrographs of (a-b) hexagonal and rectangular morphology of ZrB <sub>2</sub> (c) SAD pattern of ZrB <sub>2</sub> (d) SAD pattern of matrix and (e) dislocations present in the matrix	.69

<b>Figure 3.7 -</b>	Variation of hardness with vol. % of ZrB <sub>2</sub> particles in the composites	<b>72</b>
<b>Figure 3.8 -</b>	Variation of tensile properties with vol. % ZrB <sub>2</sub> particles	<b>73</b>
<b>Figure 3.9 -</b>	$\sigma$ vs. $\epsilon_p$ plot on log-log scale for composites	<b>74</b>
<b>Figure 3.10 -</b>	Fractographs of (a) base alloy and composites with (b) 3 vol. % ZrB <sub>2</sub> (c) 6 vol. % ZrB <sub>2</sub> (d) 9 vol. % ZrB <sub>2</sub> and (e) 10 vol. % ZrB <sub>2</sub>	<b>75</b>
<b>Figure 4.1 -</b>	Variation of cumulative wear with sliding distance at (a) 10 N (b) 20 N (c) 30 N and (d) 40 N and 1 m/s sliding velocity	<b>84</b>
<b>Figure 4.2 -</b>	Variation of COF with sliding distance at (a) 10 N (b) 20 N (c) 30 N and (d) 40 N and 1 m/s sliding velocity	<b>85</b>
<b>Figure 4.3 -</b>	Variation of wear rate with sliding velocity at (a) 10 N (b) 20 N (c) 30 N and (d) 40 N load	<b>86</b>
<b>Figure 4.4 -</b>	Variation of COF with sliding velocity at (a) 10 N (b) 20 N (c) 30 N and (d) 40 N load	<b>87</b>
<b>Figure 4.5 -</b>	Variation of wear rate with normal load at (a) 0.5 (b) 1 (c) 1.5 and (d) 2 m/s sliding velocity	<b>88</b>
<b>Figure 4.6 -</b>	Variation of wear rate per unit vol. % ZrB <sub>2</sub> with normal load at (a) 0.5 (b) 1 (c) 1.5 and (d) 2 m/s sliding velocity	<b>89</b>
<b>Figure 4.7 -</b>	Variation of COF with normal load at (a) 0.5 (b) 1 (c) 1.5 and (d) 2 m/s sliding velocity	<b>90</b>
<b>Figure 4.8 -</b>	Variation of wear rate with vol. % ZrB <sub>2</sub> at (a) 0.5 (b) 1 (c) 1.5 and (d) 2 m/s sliding velocity	<b>91</b>
<b>Figure 4.9 -</b>	Variation of specific wear rate with vol. % ZrB <sub>2</sub> at (a) 0.5 (b) 1 (c) 1.5 and (d) 2 m/s sliding velocity	<b>92</b>
<b>Figure 4.10 -</b>	Variation of normalised wear rate with vol. % ZrB <sub>2</sub> at (a) 0.5 (b) 1 (c) 1.5 and (d) 2 m/s sliding velocity	<b>93</b>
<b>Figure 4.11 -</b>	Variation of COF with vol. % ZrB <sub>2</sub> at (a) 0.5 (b) 1 (c) 1.5 and (d) 2 m/s sliding velocity	<b>94</b>
<b>Figure 4.12 -</b>	Worn surface morphology of 9 vol. % ZrB <sub>2</sub> composite after (a) 1200 m and (b) 6000 m sliding distance	<b>94</b>
<b>Figure 4.13 -</b>	2D and 3D topography of worn surface of 9 vol. % ZrB <sub>2</sub> composite after (a) 1200 m and (b) 6000 m sliding distance under profilometer	<b>95</b>
<b>Figure 4.14 -</b>	Worn surface morphology of 9 vol. % ZrB <sub>2</sub> composite at (a) 0.5 (b) 1 (c) 1.5 and (d) 2 m/s at 20 N load and 6000 m sliding distance	<b>96</b>
<b>Figure 4.15 -</b>	EDS pattern of 9 vol. % ZrB <sub>2</sub> composite at (a) 0.5 and (b) 2 m/s under 20 N load and 6000 m sliding distance	<b>97</b>
<b>Figure 4.16 -</b>	2D and 3D topography of worn surface of 9 vol. % ZrB <sub>2</sub> composite at (a) 0.5 and (b) 2 m/s sliding velocity and 20 N load after 6000 m sliding distance under profilometer	<b>98</b>
<b>Figure 4.17 -</b>	Worn surface morphology of 9 vol. % ZrB <sub>2</sub> composite at (a) 10 N (b) 20 N (c) 30 N and (d) 40 N load at 1.0 m/s sliding velocity and 6000 m sliding distance	<b>99</b>

<b>Figure 4.18</b> - 2D and 3D topography of worn surface of 9 vol. % ZrB <sub>2</sub> composite at (a) 10 N and (b) 20 N load at 1 m/s sliding velocity and 6000 m sliding distance under profilometer	<b>100</b>
<b>Figure 4.19</b> - EDS pattern of 9 vol. % ZrB <sub>2</sub> composite at (a) 10 and (b) 40 N load (c) wear debris under 1 m/s sliding velocity and 6000 m sliding distance	<b>.101</b>
<b>Figure 4.20</b> - Worn surface morphology of (a) AA5052 alloy (b) 3 vol. % ZrB <sub>2</sub> (c) 6 vol. % ZrB <sub>2</sub> and (d) 9 vol. % ZrB <sub>2</sub> composite at 1 m/s sliding velocity and 6000 m sliding distance	<b>.102</b>
<b>Figure 4.21</b> - 2D and 3D topography of worn surface of (a) AA5052 alloy and (b) 9 vol. % ZrB <sub>2</sub> composite at 1 m/s sliding velocity and 20 N load after 6000 m sliding distance under profilometer	<b>.103</b>
<b>Figure 5.1</b> - Variation of (a) UTS (b) YS and (c) percentage elongation with temperature	<b>.106</b>
<b>Figure 5.2</b> - Fractographs of composite with 9 vol. % ZrB <sub>2</sub> at different temperatures (a) RT (b) 100°C (c) 150°C and (d) 200°C	<b>.108</b>
<b>Figure 5.3</b> - Variation of wear rate with ZrB <sub>2</sub> vol. % at (a) 10 N (b) 20 N (c) 30 N and (d) 40 N load for different temperatures	<b>110</b>
<b>Figure 5.4</b> - Variation of COF with ZrB <sub>2</sub> vol. % at (a) 10 N (b) 20 N (c) 30 N and (d) 40 N load for different temperatures	<b>111</b>
<b>Figure 5.5</b> - Worn surface morphology of (a) base alloy (b) 3 vol. % ZrB <sub>2</sub> (c) 6 vol. % ZrB <sub>2</sub> and (d) 9 vol. % ZrB <sub>2</sub> composite at room temperature, 20 N load and 0.5 m/s sliding velocity	<b>112</b>
<b>Figure 5.6</b> - Worn surface morphology of (a) base alloy (b) 3 vol. % ZrB <sub>2</sub> (c) 6 vol. % ZrB <sub>2</sub> and (d) 9 vol. % ZrB <sub>2</sub> composite at 200°C temperature, 20 N load and 0.5 m/s sliding velocity	<b>.113</b>
<b>Figure 5.7</b> - 2D and 3D topography of worn surface of (a) base alloy, and (b) 9 vol. % ZrB <sub>2</sub> composite at 200°C temperature, 20 N load and 0.5 m/s sliding velocity under profilometer	<b>114</b>
<b>Figure 5.8</b> - Variation of wear rate with different temperatures at (a) 10 N (b) 20 N (c) 30 N and (d) 40 N load for different composites	<b>115</b>
<b>Figure 5.9</b> - Variation of COF with temperature at (a) 10 N (b) 20 N (c) 30 N and (d) 40 N load for different composites	<b>116</b>
<b>Figure 5.10</b> - EDS spectrum of worn surface of alloy tested at 50°C showing oxidative wear mode	<b>117</b>
<b>Figure 5.11</b> - Worn surface morphology of AA5052 - 6 vol. % ZrB <sub>2</sub> composite at (a) RT (b) 50°C (c) 100°C (d) 150°C, and (e) 200°C, at 20 N load and 0.5 m/s sliding velocity	<b>118</b>
<b>Figure 5.12</b> - Debris of composite with 6 vol. % ZrB <sub>2</sub> at (a) RT and (b) 200°C	<b>118</b>
<b>Figure 5.13</b> - 2D and 3D topography of worn surface of AA5052 - 6 vol. % ZrB <sub>2</sub> composite at (a) RT and (b) 200°C, at 20 N load and 0.5 m/s sliding velocity under profilometer	<b>119</b>
<b>Figure 5.14</b> - Variation of wear rate with different loads at (a) RT (b) 50°C (c) 100°C (d) 150°C and (e) 200°C for different composites	<b>120</b>

- Figure 5.15** - Variation of wear rate per unit vol. % ZrB<sub>2</sub> with different loads at (a) RT (b) 50°C (c) 100°C (d) 150°C and (e) 200°C for different composites **121**
- Figure 5.16** - Variation of COF with different loads at (a) RT (b) 50°C (c) 100°C (d) 150 °C and (e) 200°C for different composites **122**
- Figure 5.17** - Worn surface morphology of AA5052 - 9 vol. % ZrB<sub>2</sub> composite at (a) 10 N (b) 20 N (c) 30 N and (d) 40 N load, at 150°C and 0.5 m/s sliding velocity **124**
- Figure 5.18** - 2D and 3D topography of worn surface of AA5052 - 9 vol. % ZrB<sub>2</sub> composite at (a) 10 N and (b) 40 N load, at 150°C and 0.5 m/s sliding velocity under profilometer **125**