## Appendix

The crashworthiness indicators of different TPMS structures subjected to various rotational strategies, as obtained from finite element simulations, are presented in Table A.1.

Table A.1. Crashworthiness indicators for three types of TPMS structures.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| TPMS Structure | Rotation axis | Rotation angle | *SEA* (J/g) | *IPCF* (kN) | *MCF* (kN) | *CFE* (%) |
| Primitive | [001] | 0 | 17.77 | 41.00 | 38.71 | 94.44 |
| 15 | 18.07 | 38.30 | 38.72 | 101.09 |
| 30 | 18.68 | 40.29 | 40.69 | 101.00 |
| 45 | 19.26 | 42.08 | 40.14 | 95.39 |
| 60 | 18.48 | 39.65 | 39.84 | 100.49 |
| 75 | 18.03 | 38.31 | 38.64 | 100.87 |
| 90 | 17.77 | 41.00 | 38.71 | 94.44 |
| [011] | 0 | 32.59 | 69.83 | 68.84 | 98.58 |
| 15 | 32.28 | 69.05 | 69.51 | 100.68 |
| 30 | 32.05 | 68.05 | 68.88 | 101.21 |
| 45 | 31.53 | 68.99 | 68.72 | 99.61 |
| 60 | 32.09 | 67.64 | 68.96 | 101.95 |
| 75 | 31.98 | 68.86 | 68.83 | 99.96 |
| 90 | 32.61 | 69.53 | 68.94 | 99.15 |
| [111] | 0 | 34.96 | 81.74 | 75.96 | 92.93 |
| 15 | 35.13 | 85.13 | 78.84 | 92.61 |
| 30 | 34.99 | 82.05 | 76.04 | 92.67 |
| 45 | 35.28 | 85.57 | 79.40 | 92.79 |
| 60 | 34.97 | 81.95 | 75.93 | 92.65 |
| 75 | 35.14 | 85.18 | 78.87 | 92.60 |
| 90 | 34.98 | 82.04 | 76.05 | 92.70 |
| Gyroid | [001] | 0 | 26.64 | 55.66 | 56.95 | 102.31 |
| 15 | 27.05 | 57.33 | 58.90 | 102.73 |
| 30 | 26.85 | 55.20 | 57.60 | 104.35 |
| 45 | 26.76 | 58.14 | 58.51 | 100.64 |
| 60 | 26.85 | 56.02 | 58.61 | 104.63 |
| 75 | 27.13 | 57.11 | 59.08 | 103.47 |
| 90 | 26.81 | 57.24 | 58.59 | 102.37 |
| [011] | 0 | 29.61 | 61.50 | 64.77 | 105.33 |
| 15 | 29.38 | 58.68 | 64.01 | 109.07 |
| 30 | 28.87 | 57.93 | 63.19 | 109.08 |
| 45 | 29.61 | 59.71 | 65.52 | 109.74 |
| 60 | 29.68 | 60.15 | 65.57 | 109.00 |
| 75 | 29.40 | 60.48 | 64.82 | 107.19 |
| 90 | 30.21 | 63.47 | 67.35 | 106.10 |
| [111] | 0 | 29.35 | 65.22 | 66.05 | 101.28 |
| 15 | 28.93 | 60.95 | 63.37 | 103.96 |
| 30 | 29.32 | 65.40 | 66.01 | 100.93 |
| 45 | 28.89 | 60.92 | 63.30 | 103.90 |
| 60 | 29.30 | 65.42 | 65.98 | 100.86 |
| 75 | 28.90 | 60.93 | 63.28 | 103.86 |
| 90 | 29.35 | 65.22 | 66.07 | 101.31 |
| Diamond | [001] | 0 | 32.79 | 73.40 | 71.76 | 97.76 |
| 15 | 32.16 | 72.29 | 70.83 | 97.98 |
| 30 | 32.18 | 72.22 | 71.05 | 98.38 |
| 45 | 32.67 | 73.24 | 71.94 | 98.23 |
| 60 | 32.24 | 71.98 | 70.95 | 98.56 |
| 75 | 32.17 | 72.32 | 70.77 | 97.86 |
| 90 | 32.79 | 73.40 | 71.76 | 97.76 |
| [011] | 0 | 29.93 | 67.10 | 65.69 | 97.91 |
| 15 | 29.92 | 67.36 | 66.97 | 99.43 |
| 30 | 30.34 | 68.08 | 68.08 | 99.99 |
| 45 | 30.04 | 66.03 | 67.00 | 101.48 |
| 60 | 30.28 | 67.94 | 68.01 | 100.10 |
| 75 | 29.91 | 67.29 | 66.99 | 99.55 |
| 90 | 29.99 | 67.01 | 65.98 | 98.47 |
| [111] | 0 | 24.13 | 54.86 | 53.38 | 97.30 |
| 15 | 24.10 | 55.20 | 53.94 | 97.72 |
| 30 | 23.89 | 55.08 | 53.61 | 97.33 |
| 45 | 24.25 | 55.24 | 54.07 | 97.88 |
| 60 | 24.13 | 55.02 | 53.46 | 97.17 |
| 75 | 24.22 | 55.51 | 54.12 | 97.49 |
| 90 | 24.12 | 54.86 | 53.30 | 97.16 |