Supplementary Information

Machine learning-based solution for thermo-mechanical analysis of MMIC packaging

Sumin Kang[1,*], Jae Hak Lee[1], Seung Man Kim[1], Jaeseung Lim[1,2], Ah-Young Park[1], Seongheum Han[1], Jun-Yeob Song[1] & Seong-Il Kim[3]

[1] *Department of Ultra-Precision Machines and Systems, Korea Institute of Machinery & Materials (KIMM), Daejeon 34103, Republic of Korea.*

[2] *School of Mechanical Engineering, Chonnam National University, Gwangju 61186, Republic of Korea.*

[3] *Defense Materials & Components (DMC) Convergence Research Department, Electronics and Telecommunications Research Institute (ETRI), Daejeon 34129, Republic of Korea.*

*Author for correspondence: suminkang@kimm.re.kr

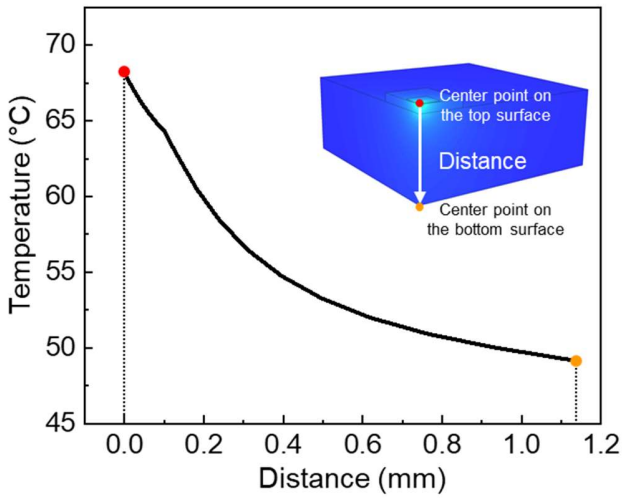

Figure S1. Variation of temperature with respect to distance from the center point on the top surface to the bottom surface.

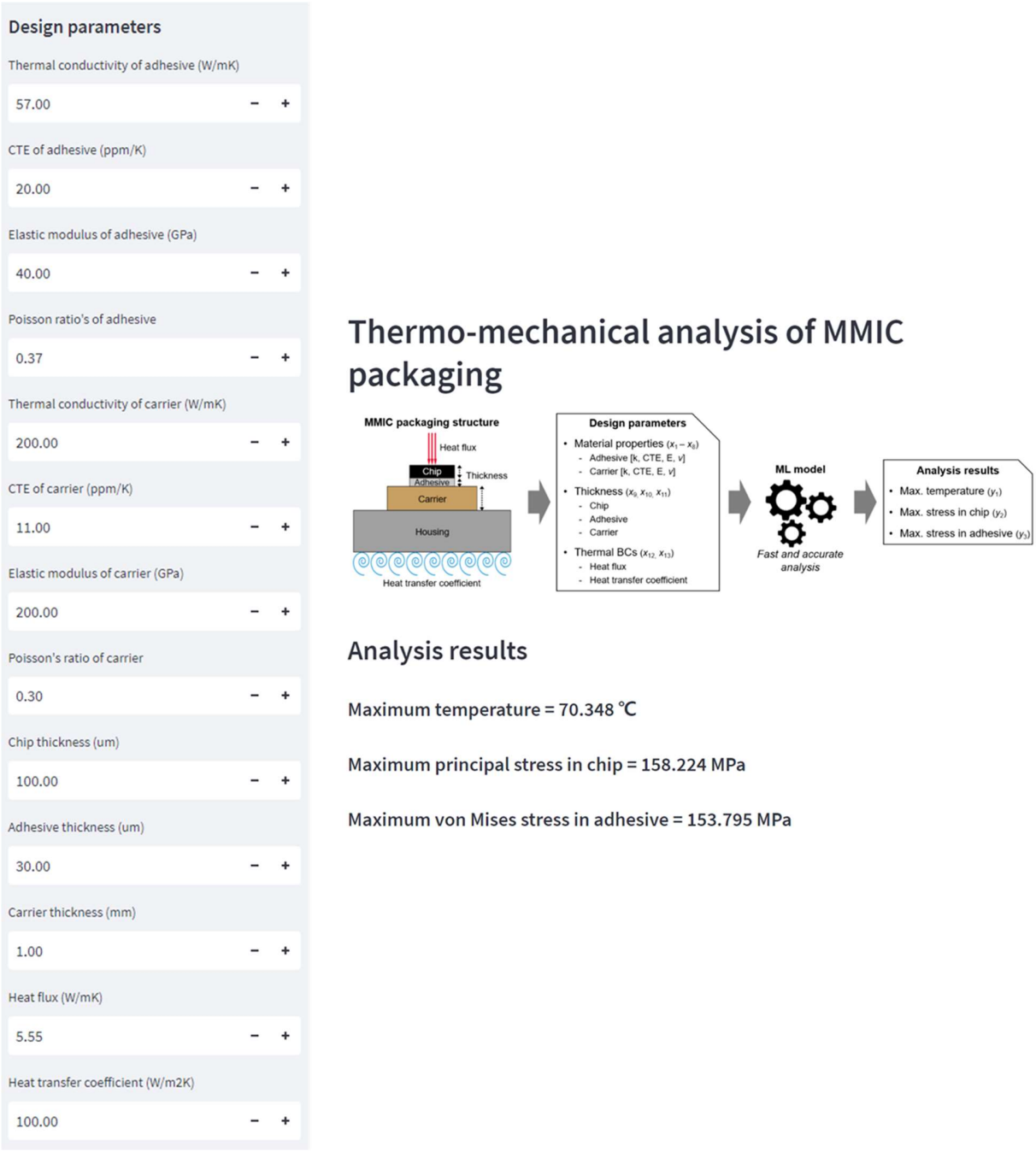

Figure S2. Web application for the thermo-mechanical analysis of MMIC packaging.

Part	Material	Thermal conductivity (W/m·K)	CTE (ppm/K)	Elastic modulus (GPa)	Poisson's ratio
Chip	4H-SiC	430	3.3	431.8	0.16
Adhesive	*Varied*	50 – 200 (x_1)	15 – 25 (x_2)	20 – 80 (x_3)	0.35 – 0.40 (x_4)
Carrier	*Varied*	150 – 450 (x_5)	5 – 23 (x_6)	50 – 350 (x_7)	0.25 – 0.35 (x_8)
Housing	Al6061	167	23.6	68.9	0.33

Table S1. Material properties of each part.

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	y_1	y_2	y_3
1	67.4	15.3	46.2	0.353	438.0	13.2	171.5	0.308	102.9	61.6	1.28	25.0	151.1	180.3	475.7	484.2
2	189.2	19.8	20.3	0.39	275.0	12.1	198.1	0.338	200.0	78.0	1.08	25.5	284.9	142.7	226.5	227.4
3	114.9	21.2	48.7	0.381	352.3	8.0	72.8	0.269	151.5	64.6	0.93	20.4	213.0	130.4	249.2	438.7
4	145.9	15.3	54.7	0.373	441.0	22.2	347.0	0.295	151.3	20.9	0.66	27.9	230.0	154.8	566.1	863.5
⋮									⋮							
39997	87.4	17.4	77.1	0.369	219.5	21.2	269.8	0.259	54.2	97.2	2.50	16.0	271.1	132.9	381.4	194.7
39998	68.7	17.3	63.4	0.393	379.2	14.9	303.6	0.316	84.2	87.9	1.18	19.1	205.4	142.6	336.5	260.3
39999	85.2	20.4	21.0	0.398	243.1	10.0	254.1	0.312	106.1	10.6	2.26	27.1	91.6	232.6	519.2	462.5
40000	124.6	17.9	60.3	0.395	349.0	20.3	70.1	0.29	34.6	20.6	2.44	27.1	93.7	227.8	1093.4	829.5

Table S2. 40,000 samples of simulation dataset.