

# Comparison of physical and mechanical properties of Heatspreader Materials

				Coefficient of Average Linear Thermal Expanion [ppm/K]					Thermal Conductivity		Specific Heat	Specific Gravity	Hardness	Transverse Rupture Strength	Tensile Strength	Young's Modulus	Poisson's Ratio	Electric Resistivity	Dielectric Constant	Application					Characteristics
				R.T. } 100°C	R.T. } 400°C	R.T. } 800°C	800°C Dependency on Direction		[W/(m•K)]																
Category	Material	Trade Name	Composition				Rolling Direction	Transverse Direction	R.T.	100°C	[kJ/(kg•K)]		[Hv]	[MPa]	[MPa]	[GPa]		[Ωm]	[at 1MHz]	Automobile and industrial machinery	LSI	Wireless communication	Opto Electronics	LD•LED	
Metals	W			4.6	–	4.7	–	–	167	159	0.13	19.3	370	–	–	380	0.284	5.5×10 <sup>-8</sup>	–	●		●		●	Low coefficient of thermal expansion Machine processing is available
	Mo			5.2	–	5.7	–	–	142	138	0.25	10.2	240	–	–	320	0.324	5.7×10 <sup>-8</sup>	–						
Metal composites, Alloy	Cu-W	W-6	94W-6Cu	5.9	6.0	6.4	–	–	141	137	0.15	17.6	330	1,000	590	350	–	–	–						C.T.E. is variable Good machinability
		W-10	89W-11Cu	6.5	7.1	7.9	–	–	174	167	0.16	17	300	1,100	560	330	0.295	5.3×10 <sup>-8</sup>	–						
		W-15	85W-15Cu	7.0	7.4	8.6	–	–	184	178	0.17	16.4	280	1,200	530	310	0.3	4.6×10 <sup>-8</sup>	–		●	●	●	●	
		W-20	80W-20Cu	7.9	8.6	9.8	–	–	200	197	0.18	15.65	260	1,300	490	280	0.305	4.0×10 <sup>-8</sup>	–						
		W-10N	89W-11Cu	6.5	7.1	7.9	–	–	200	–	0.16	17	300	1,100	560	330	–	5.3×10 <sup>-8</sup>	–						
	Cu-Mo	CM-15	85Mo-15Cu	6.8	7.3	7.6	–	–	148	144	0.28	10.01	150	1,200	540	280	–	5.3×10 <sup>-8</sup>	–						Good machinability
		PCM30	70Mo-30Cu	7.7	7.6	7.5	6.8	8.6	195	190	0.29	9.8	180	–	600	230	0.315	4.0×10 <sup>-8</sup>	–						Suitable for rolling and pressing process
		PCM35	65Mo-35Cu	8.2	8.1	7.8	7.0	9.4	210	205	0.3	9.7	175	–	560	220	–	3.5×10 <sup>-8</sup>	–						
		PCM40	60Mo-40Cu	8.8	8.5	8.2	7.2	9.8	220	215	0.31	9.6	170	–	530	210	0.32	3.4×10 <sup>-8</sup>	–						Suitable for rolling and pressing process Good heat dissipation by Cu surface layer
		RCM60	40Mo-60Cu	11.5	10.8	10.5	8.2	13.5	275	268	0.33	9.4	160	–	440	170	0.33	2.7×10 <sup>-8</sup>	–		●		●	●	
		CPC141	Cu/PCM/Cu	7.7	7.8	7.6	6.7	8.5	200	195	0.32	9.5	–	–	380	160	–	–	–						
		CPC232	Cu/PCM/Cu	10.6	8.8	8.4	7.7	9.5	235	230	0.34	9.3	–	–	350	130	–	–	–						
		CPC111	Cu/PCM/Cu	11.6	9.5	9.8	8.0	11.2	260	–	0.35	9.2	–	–	310	125	–	–	–						
CPC212	Cu/PCM/Cu	14.4	11.5	12.1	–	–	300	–	–	–	–	–	–	255	120	–	–	–							
CPC-300	Cu/PCM/Cu	13.8	11.5	12.1	8.7	13.5	300	–	0.36	9.1	–	–	290	120	–	–	–								
Ceramics	AlN	SALN-20 White		–	4.5	–	–	–	>200	>180	0.67	3.26	1,200	300	–	270	–	10 <sup>11</sup>	8.5	●	●		●	●	High T.C. and Insulator
		SALN-17 White		–	4.5	–	–	–	>170	>150															
Ceramics -Metal	Al-SiC	β8	70SiC-30Al	8.0 *1	–	–	–	–	140	–	0.73	2.6	–	240	–	130	0.26	–	–		●	●			1/3 the density of copper C.T.E. is variable Available for an aluminum skin
		β9	65SiC-35Al	9.0 *1	–	–	–	–	130	–	0.74	2.6	–	240	–	120	–	–	–						
		β14	45SiC-55Al	14.0 *1	–	–	–	–	160	–	0.78	2.6	–	280	–	100	–	–	–						
	Mg-SiC	Mg-SiC	18Mg-SiC	7.5 *1	–	–	–	–	230	200	0.74	2.7	–	400	–	140	–	–	–	●					Same low C.T.E. as Al-SiC and high T.C.
Diamond	DMCH Diamond-Cu	DC60	Diamond-Cu	–	6.0	–	–	–	550	530	0.45	5.0	–	–	480	560	0.17	1.9×10 <sup>-7</sup>	–		●	●	●	●	High T.C.
		DC70		–	6.5	–	–	–	500	480	0.44	5.5	–	–	–	–	–	1.7×10 <sup>-7</sup>	–						
	Sumicrystal			2.3	–	–	–	–	2,000	1,400	0.51	3.52	9,000~10,000	3,900	–	1,050	–	10 <sup>14</sup>	5.7				●	●	High T.C. and Insulator
	CVD-Diamond			2.3	–	–	–	–	>1,000	–	0.51	3.52	9,000~10,000	1,000	–	1,050	–	5×10 <sup>7</sup>	5.8						
Reference data	Semiconductor	Si		3.0 *2			–	–	151	–	0.75	2.3	–	200	–	170	–	2.3×10 <sup>-3</sup>	11.7						
		GaAs		5.9 *2			–	–	46	34	0.33	5.32	–	–	290	90	–	3.8×10 <sup>-6</sup>	11.1						
		InP		4.5 *2			–	–	70	–	0.32	4.79	–	–	–	60	–	8.2×10 <sup>-7</sup>	12						
		GaN		a5.6-c3.2 *2			–	–	130	–	0.49	6.15	–	–	–	–	–	–	–						
		SiC		3.1 *2			–	–	490	–	0.69	3.2	–	–	–	221	–	–	10						
	Ceramics	Al <sub>2</sub> O <sub>3</sub>		6.0	7.2	8.1	–	–	17	17	0.8	3.6	1,900	300	–	370	–	10 <sup>12</sup>	8.9						
		BeO		7.6 *2			–	–	251	180	0.96	2.9	1,200	200	–	330	–	10 <sup>13</sup>	6.7						
		SiO <sub>2</sub>		3.0 *2			–	–	1.4	–	–	0.7	–	–	–	–	–	–	–						
		High C.T.E. Glass Ceramics			11.5 *2			–	–	0.2	–	–	1	–	–	–	–	–	–						
	Metals	Cu		17.1	–	19.4	–	–	394	–	0.38	8.93	80	–	250	120	–	1.7×10 <sup>-8</sup>	–						
Al		24.3	26.5	–	–	–	238	–	0.27	2.7	–	–	–	80	–	–	–								
Kovar		5.3 *2			–	–	17	17	0.44	8.36	160	–	540	140	–	4.9×10 <sup>-7</sup>	–								
Organic	FR-4		x15-y17 *2			–	–	0.2	–	–	–	–	–	–	–	–	–	–							
	Polyimide		25 *2			–	–	0.2	–	–	–	–	–	–	–	–	–	–							

\*1 R.T.~120°C

\*2 Unknown the Temperature Range