

Comparison of Physical and Mechanical Properties of Heat spreaders

					Coefficient of Average Linear Thermal Expansion [$\times 10^{-6}/K$]					Thermal Conductivity [$W/(m \cdot K)$]		Specific Heat [$kJ/(kg \cdot K)$]	Density [g/cm^3]	Hardness [Hv]	Transverse Rupture Strength [MPa]	Tensile Strength [MPa]	Young's Modulus [GPa]	Poisson's Ratio	Electric Resistivity [Ωm]	Dielectric Constant [at 1MHz]	Application																												
					R.T. $\sim 100^\circ C$	R.T. $\sim 400^\circ C$	R.T. $\sim 800^\circ C$	R.T. $\sim 800^\circ C$ Anisotropy		R.T.	100°C										Wireless Communications	Optical Communications	Automotive	High Luminance LEDs	Lasers	Power Generators	Electric Railways	Industrial Machinery																					
								Rolling Direction	Transverse Direction																																								
Category	Material	Name	Composition																																														
Metals	W			4.6	—	4.7	—	—	167	159	0.13	19.3	370	—	—	380	0.284	5.5×10^{-8}	—			●	●		●																								
	Mo			5.2	—	5.7	—	—	142	138	0.25	10.2	240	—	—	320	0.324	5.7×10^{-8}	—						●																								
Metal Composites, Alloy	CPC®	CPC141	Cu/Cu-Mo/Cu (Cu/PCM/Cu)	7.7	7.8	7.6	6.7	8.5	200	195	0.32	9.5	—	—	380	160	—	—	—																														
		CPC232		10.6	8.8	8.4	7.7	9.5	235	230	0.34	9.3	—	—	350	130	—	—	—																														
		CPC111		11.6	9.5	9.8	8.0	11.2	260	—	0.35	9.2	—	—	310	125	—	—	—	—	●	●	●																										
		CPC212		14.4	11.5	12.1	—	—	300	—	—	—	—	—	255	120	—	—	—	—																													
		CPC-300		13.8	11.5	12.1	8.7	13.5	300	—	0.36	9.1	—	—	290	120	—	—	—	—																													
	Cu-Mo	CM-15	85Mo-15Cu	6.8	7.3	7.6	—	—	148	144	0.28	10.01	150	1,200	540	280	0.42	5.3×10^{-8}	—																														
		CM-15K	85Mo-15Cu	7.0	7.4	8.2	—	—	173	169	0.28	10	171	1,296	551	280	0.42	4.6×10^{-8}	—																														
		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^{-8}	—	●	●	●	●																										
		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^{-8}	—																														
		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^{-8}	—																														
	Cu-W	W-6	94W-6Cu	5.9	6.0	6.4	—	—	141	137	0.15	17.6	330	1,000	590	350	—	—	—																														
		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^{-8}	—																														
		W-15*1	85W-15Cu	7.0	7.4	8.6	—	—	184	178	0.17	16.4	280	1,200	530	310	0.3	4.6×10^{-8}	—	●	●		●	●																									
		W-20*1	80W-20Cu	7.9	8.6	9.8	—	—	200	197	0.18	15.65	260	1,300	490	280	0.305	4.0×10^{-8}	—																														
		W-10T	89W-11Cu	6.5	7.1	7.9	—	—	205	—	0.16	17	300	1,100	560	330	—	—	—																														
Ceramics	AlN	AlN(230W)		—	4.5	—	—	—	230	—	0.72	3.27	950	320	—	300	—	10^{13}	8.5																														
		AlN(200W)		—		—	—	—	200	—																																							
		AlN(170W)		—		—	—	—	170	—																																							
Ceramics -Metal	Mg-SiC	MAGSIC®	18Mg-SiC	7.0*2	—	—	—	—	230	200	0.74	2.8	—	400	—	140	—	3.5×10^{-7}	—																														
Diamond	Diamond-Metal	AD90	Ag-Diamond	—	9.5	11.2	—	—	600	—	0.34	5.9	—	—	390	340	0.24	7.3×10^{-8}	—	●																													
		DC60	Cu-Diamond	—	6.0	—	—	—	550	530	0.45	5.0	—	—	480	560	0.17	1.9×10^{-7}	—																														
		DC70		—	6.5	—	—	—	500	480	0.44	5.5	—	—	—	—	—	1.7×10^{-7}	—																														
	CVD diamond			2.3	—	—	—	—	>1,000	—	0.51	3.52	9,000~10,000	1,000	—	1,050	—	5×10^7	5.8																														
SUMICRYSTAL™			2.3	—	—	—	—	2,000	1,400	0.51	3.52	9,000~10,000	3,900	—	1,050	—	10^{14}	5.7																															
Reference Data	Semiconductor	Si		3.0*3			—	—	151	—	0.75	2.3	—	200	—	170	—	2.3×10^{-3}	11.7																														
		GaAs		5.9*3			—	—	46	34	0.33	5.32	—	—	290	90	—	3.8×10^{-6}	11.1																														
		InP		4.5*3			—	—	70	—	0.32	4.79	—	—	—	60	—	8.2×10^{-7}	12																														
		GaN		a5.6-c3.2*3			—	—	130	—	0.49	6.15	—	—	—	—	—	—	—	—																													
		SiC		3.1*3			—	—	490	—	0.69	3.2	—	—	—	221	—	—	10																														
	Ceramics	Al ₂ O ₃		6.0	7.2	8.1	—	—	17	17	0.8	3.6	1,900	300	—	370	—	10^{12}	8.9																														
		BeO		7.6*3			—	—	251	180	0.96	2.9	1,200	200	—	330	—	10^{13}	6.7																														
		SiO ₂		3.0*3			—	—	1.4	—	—	0.7	—	—	—	—	—	—	—																														
		High C.T.E. Glass Ceramics		11.5*3			—	—	0.2	—	—	1	—	—	—	—	—	—	—	—																													
	Metals	Cu		17.1	—	19.4	—	—	394	—	0.38	8.93	80	—	250	120	—	1.7×10^{-8}	—																														
		Al		24.3	26.5	—	—	—	238	—	0.92	2.7	—	—	—	80	—	—	—																														
Kovar		5.3*3			—	—	17	17	0.44	8.36	160	—	540	140	—	4.9×10^{-7}	—																																
Organic	FR-4		x15-y17*3			—	—	0.2	—	—	—	—	—	—	—	—	—	—																															
	Polyimide		25*3			—	—	0.2	—	—	—	—	—	—	—	—	—	—	—																														

* 1 We have "T Grade", which has higher thermal conductivity. * 2 R.T.~120°C * 3 Unknown the Temperature Range

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