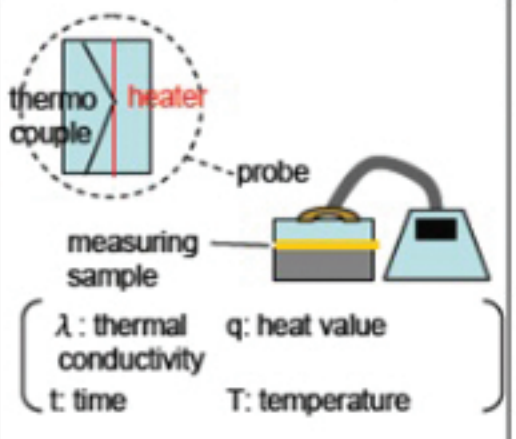
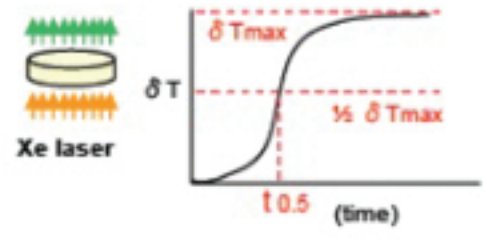
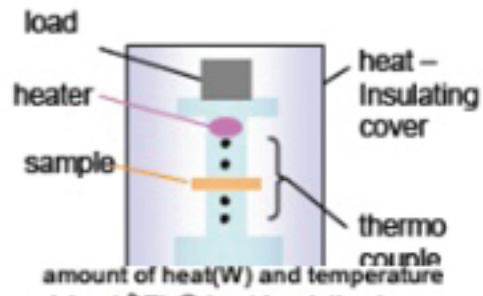
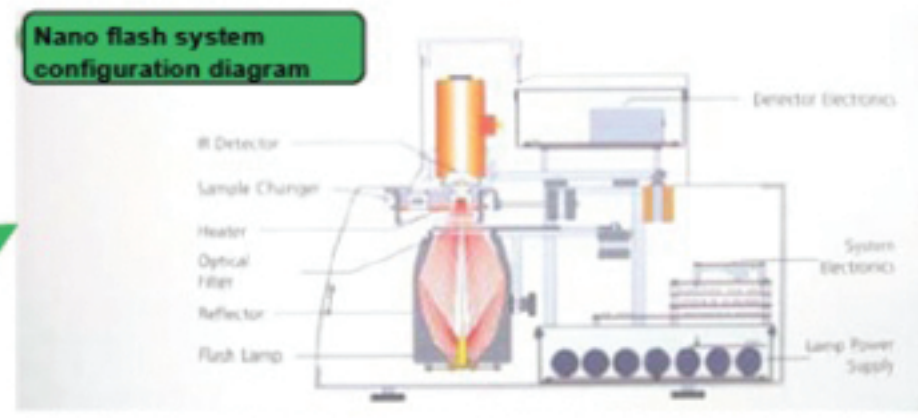
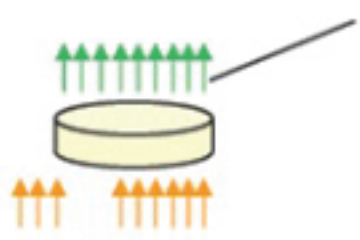
Properties	KNDJ003	KNDJ002	KNDJ001	remarks
Thickness	50~300 μm	50~300 μm	80~300 μm	IPC 4101
Thermal conductivity	1.0 W/m·K	2.3 W/m·K	2.8 W/m·K	ASTM E1461
Tg	136℃	125℃	122℃	DMA
CTE(<Tg/ >Tg)	41ppm/127ppm	34ppm/123ppm	11ppm/29ppm	TMA
E' (-50℃)	11,000 MPa	19,000 MPa	26,000 MPa	DMA
E' (25℃)	6,800 MPa	15,000 MPa	21,000 MPa	
E' (120℃)	1,800 MPa	1,100 MPa	1,900 MPa	
Young's modulus	3.8 GPa	5.1 GPa	18.0 GPa	Tensile test
Water absorption rate	< 0.5%	< 0.5%	< 0.5%	121℃/2.1atm/100RH% 2h
Breakdown voltage (AC)	> 6 kV/mm	> 6kV/mm	> 4 kV/mm	ASTM D149 (Test condition A)
Surface resistivity	*1.5E+17 Ω / —*	*5.6E+17 Ω / 3.3E+17 Ω*	*1.9E+17 Ω / 2.7E+17 Ω*	JIS K6911 (Test condition A / 35℃ 90RH% 96 h)
Volume resistivity	*4.5E+18 Ω·cm / —*	*8.7E+18 Ω·cm / 4.3E+18 Ω·cm*	*6.0E+18 Ω·cm / 1.9E+18 Ω·cm*	
Cu peel strength (1oz)	1.5 kgf/cm	*1.5kgf/cm*	*1.6 kgf/cm*	JIS C6481(Test condition A)
	1.5 kgf/cm	*1.5kgf/cm*	*1.7 kgf/cm*	JIS C6481(@ 120℃)
	1.4 kgf/cm	*1.5kgf/cm*	*1.5 kgf/cm*	Heat treatment (260℃ 2min)
	1.4 kgf/cm	*1.5 kgf/cm*	*1.5 kgf/cm*	Heat treatment (288℃ 2min)
Dielectric constant (1MHz)	*4.5~5.5*	*5.5~6.5*	*7.5~8.0*	*Static capacitor method*
Dielectric loss tangent (1MHz)	*0.022*	*0.029*	*0.0112*	
Solder float (288℃)	> 20min	> 20min	> 20min	High power hot plate
Solder float (300℃)	> 10min	> 10min	> 10min	

Measuring method (Standard)	Hot wire type (ASTM C1113)	Laser flash type (ASTM E1461)	Thermal resistance type (ASTM D5470)
Maker	 KEM co. ltd QTM500etc.,	 NETZSCH co. ltd LFA447 etc.,	 Analysis tech co., ltd TIM tester 1300 etc.,
Principle of measurement		 Calculate the thermal conductivity from temperature rising curve by simulation fitting.	 amount of heat(W) and temperature rising (δ T) @ heat insulating box. ⇒Convert the thermal conductivity λ =h /(R·A) h: thickness R: thermal resistance A: sample area
Features	Thin film sample × : >300 μm Contact measuring (Low precision because of contact thermal resistance @ probe/sample)	Thin film sample OK Non contact measuring (high precision) Multi layer sample OK (CCL etc.,)	Standard for thermal resistance measuring (※Have a tendency to show high thermal conductivity)

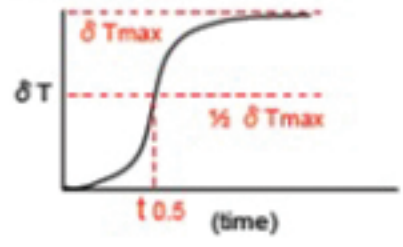
Nano flash system configuration diagram



< principle of measurement >



Calculate the thermal conductivity from temperature rising curve by simulation fitting.



$$\alpha = 0.1388 \frac{l^2}{t^{0.5}}$$

α: t(cm2/s)

l: sample thickness(cm)

$t^{0.5}$: half time of maximum temperature rising(sec)

$$\lambda = \alpha \cdot Cp \cdot \rho$$

Cp: Heart capacity(J/g·k)

ρ: sample density(g/cm3)

①Single layer sample measuring

Calculate the thermal conductivity from sample Thickness, Cp and ρ.

Simulation model: Cowan+
Baseline model: Linear

②Triple layer (CCL) sample measuring

Input the characteristic value of Cu and AL

Simulation model: 3heatloss+
Baseline model: Linear

Calculate the thermal conductivity from sample thickness, Cp, ρ and characteristic value of Cu & AL.