General Description of Muscovite Mica

Mica discs and sheets provided by NanoAndMore are intended for use with scanning probe microscopy, electron microscopy and thin film applications. The mica offered is the muscovite sheet type or ruby mica in the highest grade V-1 quality. Selected for its excellent cleavability and lack of inclusions or bubbles. It is transparent or translucent with a shade of ruby to pink. Mica is a natural mineral and is mined from various deposits. The density is 2.7-3g/cm3 with the chemical formula Kal3Si3O10(OH)2. The mica provided by NanoAndMore is sourced from one of the highest quality muscovite sheet mica deposits in India.

To use mica, it must be freshly cleaved to produce a clean substrate. The freshly cleaved surfaces are clean, even and atomically flat surfaces which are ideal for carbon filming, AFM substrate and thin film applications.

The thickness of the Nano-Tec muscovite mica discs and sheets varies from 0.15-0.21mm and yields multiple thinner sheets (0.02mm) of freshly cleaved mica. Mica cleaves on the <001> plane. Methods of cleaving can be:

insert a sharp blade or point into the edge and peel a fresh sheet off

place double sided tape on the mica and peel off a thin sheet, starting at the edge.

Mica is a dielectric material, stable in water, inert to most acids, alkalis, solvents and oil. Maximum operating temperature is 500-600°C.

Physical properties of V-1 grade muscovite sheet mica

Parameter	Unit	Number
Colour		ruby / pink / green
Hardness	Mohs	2.8 – 3.2
Density	g/cm^3	2.6 – 3.2
Tensile strength	kg/cm^2	~1750
Shear strength	kg/cm^2	2200 – 2700
Compression strength	kg/cm^2	1900 – 2850
Modulus of Elasticity	g/cm^2	1400 – 2100
Specific Heat		0.21
Expansion Coefficient per °C perpendicular to cleavage plane		9x 10-6 – 36 x 10-6
Maximum operating temperature	°C	500 – 600
Thermal conductivity perpendicular	$g.cal/sec/cm^2/°C/cm$	0.13x 10-3
Thermal conductivity parallel	$g.cal/sec/cm^2/°C/cm$	0.31
Dielectric strength @20 °C	KV/mm	3 – 5
Apparent electric strength	KV/mm	120 – 200
Volume resistivity @ 25 °C	Ohm.cm	4 x10-15 – 2x10-17
Power factor (loss tangent) @ 15 °C		0.0001 – 0.0004
Optical angle	degree	50 – 75
Refractive index		1.56 – 1.61

Permittivity @15 °C		6 – 7
Calcining temperature	°C	700 – 800
Water of constitution	%	4.5
Moisture absorption		Very low

Chemical composition of V-1 muscovite mica:

Element or compound	Composition in %
Silica – SiO2	45.57
Alumina – Al2O3	33.1
Potassium Oxide – K2O	9.87
Iron Oxide – Fe2O3	2.48
Sodium Oxide – Na2O	0.62
Carbon – C	0.44
Magnesia – MgO	0.38
Calcium Oxide – CaO	0.21
Phosphor – P	0.03
Sulphur – S	0.01
Titanium Dioxide – TiO2	traces
H2O @ 100 C	0.25
H2O loss on ignition	2.74

Visual grading classification system description for sheet mica

The quality of muscovite mica is determined by visual inspection according to ASTM D351-571 from the highest quality V1 to the V12 (V-10A)

1. V-1: Clear - Hard, of uniform colour, nearly flat, free of all stains, foreign inclusion, cracks, and other similar defects.
2. V-2: Clear and Slightly Stained - Hard, of uniform color, nearly flat and may contain slight crystallographic discoloration, and very slight air inclusions in not more than one fourth of the usable area.
3. V-3: Fair Stained - Hard, of uniform color, may contain slight waves, slight crystallographic discoloration, and sligh air inclusions in not more than one-half of the usable area.
4. V-4: Good Stained - Hard, of uniform color, may contain medium waves slight crystallographic discoloration, and medium air inclusion in not more than two-third of the usable area.
5. V-5: Stained A Quality - Hard, may contain medium air inclusions, uniformly distributed in the usable area; slight green vegetable stains, medium waviness, and heavy waves if specified.
6. V-6: Stained B Quality - Hard, may contain heavy air inclusions and heavy waves, medium green vegetable stains, slight black and red dots (mineral) and clay stains.

7. V-7: Heavy Stained - Hard, and may contain heavy air inclusions and waves, slight light black and red dots (mineral), medium cloudy stains, clay stains and green stains (vegetable). Soft, buckles, ridges, and sand blast acceptable if specified.
8. V-7A: Densely Stained - Hard and soft. May contain heavy waves and air inclusions, cloudy stains. High black and red dots (mineral). Medium black and red stained (mineral), buckles, and ridges. Also, green stain (vegetable type), clay stains, herringbones, and sand blast.
9. V-8: Black Dotted - Hard, may contain medium waves, heavy air inclusions, cloudy stains, light black and red dots (mineral), and green stains (vegetable).
10. V-9: Black Spotted - Hard, may contain medium waves, heavy air inclusions, cloudy stains, light black and red dots (mineral), and green stains (vegetable type), slight black stains (mineral), and sand blast.
11. V-10: Black Stained - Hard, may contain medium waves, heavy air inclusions, cloudy stains, light black and red dots (mineral), green stains (vegetable type), and sand blast, medium black stains (mineral), slight red stains (mineral), and clay stains.
12. V-10A: Densely Black and Red Stained - Hard, may contain heavy waves, air inclusion, cloudy stains, light black and red dots (mineral), red stains (mineral), black and red stains (mineral), green stains (vegetable type), and sand blast, very dense black and red stains (mineral), and slight clay stains. Soft if specified.

Grading classification for sheet mica

QUALITY CLASSIFICATION OF MUSCOVITE MICA BASED ON VISUAL PROPERTIES												
	V-1 Clear Highest Quality	V-2 Clear and Slightly Stained	V-3 Fair Stained	V-4 Good Stained	V-5 Stained A Quality	V-6 Stained B Quality	V-7 Heavy Stained	V-7A Densely Stained	V-8 Black Dotted	V-9 Black spotted	V-10 Black Stained	V-10A Densely Black & Red Stained
Crystallographic Discoloration	X	*d	*d	*d	*	*	*	*	*	*	*	*
Very Slight	X	*	*	*	*	*	*	*	*	*	*	*
Slight	X	X	*	*	*	*	*	*	*	*	*	*
Medium	X	X	X	*e	*f	*	*	*	*	*	*	*
Heavy	X	X	X	X	X	*	*	*	*	*	*	*
Cloudy Stains	X	X	X	X	X	X	*g	*h	*	*	*	*
Light Black and Red Dots (Mineral)	X	X	X	X	X	*d	*d	*h	*	*	*	*
Black Stains (Mineral)	X	X	X	X	X	X	X	*g	X	*d	*g	*h
Red Stains (Mineral)	X	X	X	X	X	X	X	*g	X	X	*d	*
Black and	X	X	X	X	X	X	X	X	X	X	X	*

Red Stains (Mineral)												
Green Stains (Vegetable Type)	X	X	X	X	*d	*g	*g	*	*	*	*	*
Clay Stains	X	X	X	X	X	*d	*g	*	X	X	*d	*d
Nearly Flat	*	*	*	*	*	*	*	*	*	*	*	*
Slight	X	X	*	*	*	*	*	*	*	*	*	*
Medium	X	X	X	*	*	*	*	*	*	*	*	*
Heavy	X	X	X	X	X	*	*	*	X	X	X	*
Hard	*	*	*	*	*	*	*	*	*	*	*	*
Soft	X	X	X	X	X	X	S	*	X	X	X	S
Stones and Holes	X	X	X	X	X	X	X	X	X	X	X	X
Buckles	X	X	X	X	X	X	S	*g	X	X	X	X
Reeves	X	X	X	X	X	X	X	X	X	X	X	X
Ridges	X	X	X	X	X	X	S	*g	X	X	X	X
Tears	X	X	X	X	X	X	X	X	X	X	X	X
Cracks	X	X	X	X	X	X	X	X	X	X	X	X
Hairline Cracks	X	X	X	X	X	X	X	X	X	X	X	X
Wedge	X	X	X	X	X	X	X	X	X	X	X	X
Tangle Sheet	X	X	X	X	X	X	X	X	X	X	X	X
Herringbones	X	X	X	X	X	X	X	*	X	X	X	X
Sand Blast	X	X	X	X	X	X	S	*	X	*	*	*

Explanation Symbols	
Permissable	*
Not Permissable	X
Permissable Only If Specified	S
Few And Tiny In 1/4 Of Usable Area	a
In 1/2 Of Usable Area	b
Very Dense	c
Slight	d
In 2/3 Of Usable Area	e
Uniformly Distributed	f
Medium	g
Heavy	h