Pylux™ MF | Microfabrication on Plastic Made Easy

Ares Materials — Flexible electronics unleashed

Specifications/Properties

Property	Measurement Range	Value	Units	Method
Physical				
Ultimate Tensile Strength	25 °C	55	MPa	ASTM D1708
Ultimate Elongation	25 °C	5	%	ASTM D1708
Young's Modulus	25 °C	3	GPa	ASTM D1708
Folding Endurance (R=2mm)	-	>200K	cycles	-
Thermal				
Coefficient of Thermal Expansion (in-plane;linear)	0 - 50 °C 50 - 250 °C	35 150	ppm/°C	ASTM E831
Surface Roughness	100 μM^2	<0.5	nm	AFM
Glass Transition (T_g)	-40 - 200 °C	53	°C	ASTM E1356
Thermal Degradation - 1% ($T_{1\%}$)	25 - 700 °C	275	°C	ASTM E2550
Thermal Degradation - 5% ($T_{5\%}$)	25 - 700 °C	360	°C	ASTM E2550
Thermal Degradation - Onset (T_d)	25 - 700 °C	370	°C	ASTM E2550
Optical				
Optical Transmission	425 - 800 nm	>90	%	ASTM D1003
Haze	-	<1	%	ASTM D1003
b*	-	<1	-	ASTM E317
Refractive Index (nD)	25 °C	1.555	-	ASTM D542
Birefringence (@ 632.8 nm)	2,000 mm^2	4.2 x 10^{-6}	-	ASTM D4093
Chemical Compatibility[a]				
Polar Protic Solvent (e.g. water)	25 °C	GOOD	-	Ares Method
Polar Aprotic Solvent (e.g. acetone)	25 °C	GOOD[b]	-	Ares Method
Nonpolar Solvent (e.g. chloroform)	25 °C	GOOD	-	Ares Method
Weak / Strong Acid (e.g. 1.0M HCl)	25 °C	EXCELLENT	-	Ares Method
Weak Base (e.g. 3% TMAH)	25 °C	EXCELLENT	-	Ares Method
Strong Base (e.g. 1.0M KOH)	80 °C	POOR	-	Ares Method

[a] no observable change in material properties and dimension for:
EXCELLENT - >30min / GOOD – 10-30min / FAIR – 5-10 min / POOR - <5min
[b] will not damage material, but will swell significantly

Pylux-MF has been specifically formulated for microfabrication. Films can be processed indefinitely at 275°C, and up to 300°C for short periods of time (e.g. 30min).

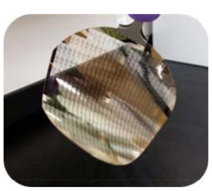
Pylux-MF offers exceptional optical performance, with >90% visible spectrum transmittance, <0.5% haze, low b* (yellow index), and superb optical retardation (as good as glass).

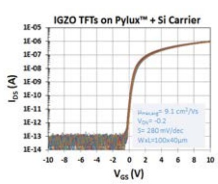
In addition, as all products in the Pylux™ family, it is 100% UV curable, solvent-free, with exceptionally smooth surface after curing (Ra<0.5nm).

Combined with our proprietary release layer (ATB-Series), films can be easily detached from a rigid carrier via mechanical peeling, at the end of the fabrication.

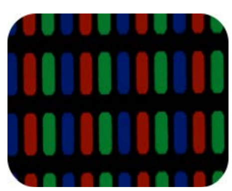
Pylux-MF offers an **unparalleled combination of optical, chemical and thermo-mechanical properties** in addition to **low processing cost** to meet the demands of flexible displays and electronics.

Application Examples





Pylux™ MF with IGZO-TFTs



Flexible CF Array on Pylux™ MF

To request samples, or for further information please contact:

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Microfabrication above the Glass Transition

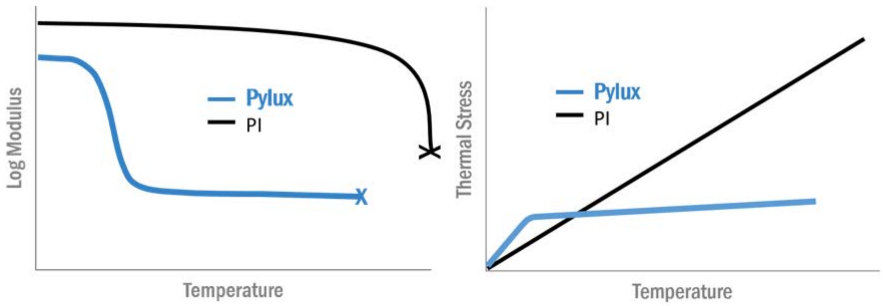

Figure 1. (a) Log-linear example plot of Young's modulus vs. temperature for Pylux™-MF and general polyimides, with thermal degradation temperatures represented by 'X's. (b) Total thermal stress in thin-films deposited atop each substrate as a function of temperature.

While Pylux™-MF films have a lower glass transition (Tg) and a higher coefficient of thermal expansion (CTE) compared to currently used substrates for flexible electronics, these parameters actually comprise the principle used to allow Pylux™-MF to introduce lower stresses related to thermal-cycling thin-films deposited atop Pylux™-MF. The primary mechanism behind this stress reduction is related to (a) the lowered Young's modulus (E) of Pylux™-MF throughout the entire deposition and (b) the Tg that further reduces the modulus another two orders-of-magnitude at the low temperature of 55 °C. An often-cited example for understanding thin-film stresses which accumulate in multi-layer structures are the modified Stoney formulas presented by Dauskardt et al.[1] In these calculations, the total stress observed by a thin-film (σ) for two substrates of equal dimensions reduces to a direct proportionality between the thin-film stress and the Young's modulus of the substrate. As shown above in Figure 1a, this is reflected by the low Tg and lowered glassy E of Pylux™-MF. Effectively, this translates to a lowered buildup of thermal stress in the thin-films deposited atop the substrate material (Figure 1b), where despite the higher thermal stress ramp rate close to Tg for Pylux™-MF, the transition from a glass to a rubber allows for a more attenuated thermal stress buildup at temperatures subsequent to the Tg. While only a brief overview of the mechanics under which Pylux™-MF operates to accommodate mechanical mismatch with a variety of thin-film materials, the explanation serves as a good starting point for exploring the use of alternative substrates for flexible electronics.

[1] Dauskardt, R. H., et al. "Adhesion and debonding of multi-layer thin film structures." Engineering Fracture Mechanics 61.1 (1998): 141-162.

OVERVIEW

Pylux-MF films are electronic-grade polysulfide thermosets specifically designed as substrates for microfabrication of thin-film components at temperatures up to 300 °C. Blending excellent thermal stability, chemical compatibility and optical clarity, Pylux-MF substrates enable high-temperature microfabrication on transparent organic substrates.

SELECT USES

1. Metal-oxide thin-film transistors.
2. Printed electronics.
3. Color filters.