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TECHNICAL REPRINT:

X-Ray Fluorescence Thin--Film Sample Supports

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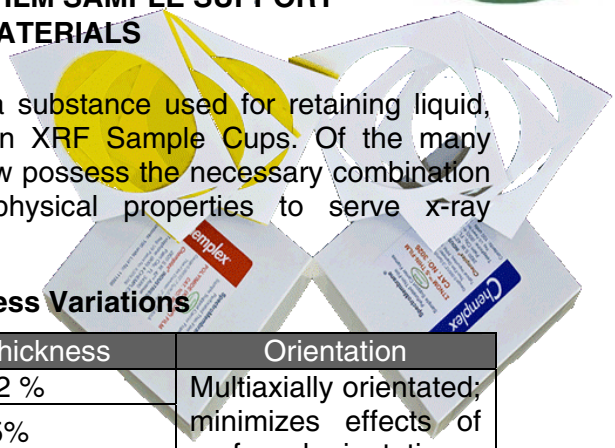
TECHNICAL INFORMATION

SPECTROCERTIFIED® THIN-FILM SAMPLE SUPPORT WINDOW MATERIALS



A thin-film sample support window is a substance used for retaining liquid, powdered, slurry or solid specimens in XRF Sample Cups. Of the many different types of materials available, few possess the necessary combination of consistency and chemical and physical properties to serve x-ray spectrochemical needs.

Typical Thickness Variations

Variations	Uniformity of Thickness	Orientation
Between packages	≤ 1 – 2 %	Multiaxially orientated; minimizes effects of preferred orientation
Between lots	≤ ± 5%	

Physical Characteristics

Thin-Film Sample Support Substance	Melting Point, °C (°F)	Density, gm/cc	Structural Formula
Etnom®	270 (518)	1.36	$C_{14}H_{10}O_4$
Prolene®	165 (329)	0.91	C_3H_6
Mylar®	260 (500)	1.38	$C_{10}H_3O_4$
Polypropylene	160 (320)	0.91	C_3H_6
Ultra-Polyester™	210 (410)	0.93	$C_{10}H_3O_4$
Polyimide (Kapton®)	None reported	1.42	$C_{20}H_{10}O_5N_2$
Polycarbonate	267 (513)	1.37	C_2H_3F

Purity

(Refer to "Chemical Resistance Chart" for Additional Information)

Thin-Film Window Substance	Trace Impurities, PPM
Mylar®, Ultra-Polyester™	Ca, P, Sb, Fe, Zn
Prolene®, Polypropylene	Ca, P, Fe, Cu, Zr, Ti, Al
Etnom®	Si, Ca, P, Zn, Sb
Polyimide (Kapton®)	Unknown
Polycarbonate	Unknown

CAUTION: All thin-film window materials affixed to sample cups present the risk of stretching or rupturing in the sample chamber and/or causing sample cup leakage through the ring and cell juncture or disassembly with potential contamination and damage to the system. These conditions are especially amplified when the sample chamber is subjected to a change in pressure attributed to evacuation, introduction of an inert gas flush or from pressure build-up within the sample cup from a sample substance out gassing or from volatility. Additionally, the possibility of pinholes, pores and depressions existing in any thin-film sample support substance regardless of form, configuration and packaging can present leakage of a sample with subsequent contamination and damage to the analytical instrumentation and it components. It is strongly recommended that the products used be subject to judicious testing, use and applications and user evaluation prior to actual use by a method that does not risk contamination or damage to the x-ray analytical spectrometer. The responsibility of product acceptance and performance resides totally with the user. Chemplex Industries, Inc. assumes no liability or guarantees whatsoever that the products will perform in accordance with their usage, advertisements or methodologies written, orally expressed, implied or insinuated.

XRF THIN-FILM SAMPLE SUPPORT WINDOWS

Chemplex INDUSTRIES, INC.

HOME

QUICK REFERENCE CHART FOR XRF SAMPLE CUPS

CONTINUOUS ROLLS AND PRECUT CIRCLES

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HOW TO SELECT A THIN-FILM SAMPLE SUPPORT WINDOW MATERIAL

Selection of a suitable thin-film sample support window is mostly based on satisfying primary important laboratory requirements:

- Convenience of use; contamination avoidance
- Analyte-line transmittance and intensity
- Chemical resistance to samples

The information presented entails the main packaging forms thin-films are offered, the various types of thin-films, a methodology for evaluating an appropriate thin-film for maximizing analyte-line percent transmittance and the resistance to sample chemical attack. Other issues of laboratory concern may include sample weight retention strength, performance under differential pressure conditions, integration time, excitation potential and related heat generation.

1. CONVENIENCE OF USE AND CONTAMINATION AVOIDANCE

Dispensing and handling a thin-film in attempting to prepare a sample cup with a sample support window is frustrating, inconvenient and a source for contamination. This is attributed to the static electrical charges inherent to the thin-films that create static cling. The thin-film tends to stick to any surrounding object and one's person. This phenomenon presents the potential of contaminating the thin-film and affecting analytical x-ray data.

With the advent of SpectroMembrane® Sample Support Carrier Frames, there is no annoying static cling or potential contamination risk to the thin-film through handling or attraction of airborne particles. With the exception of the sample cup, the thin-film is never in intimate contact with anything else. Thin-film handling is performed by the use of the integrated carrier frames that automatically detach during the assembly process leaving taut thin-film sample planes.

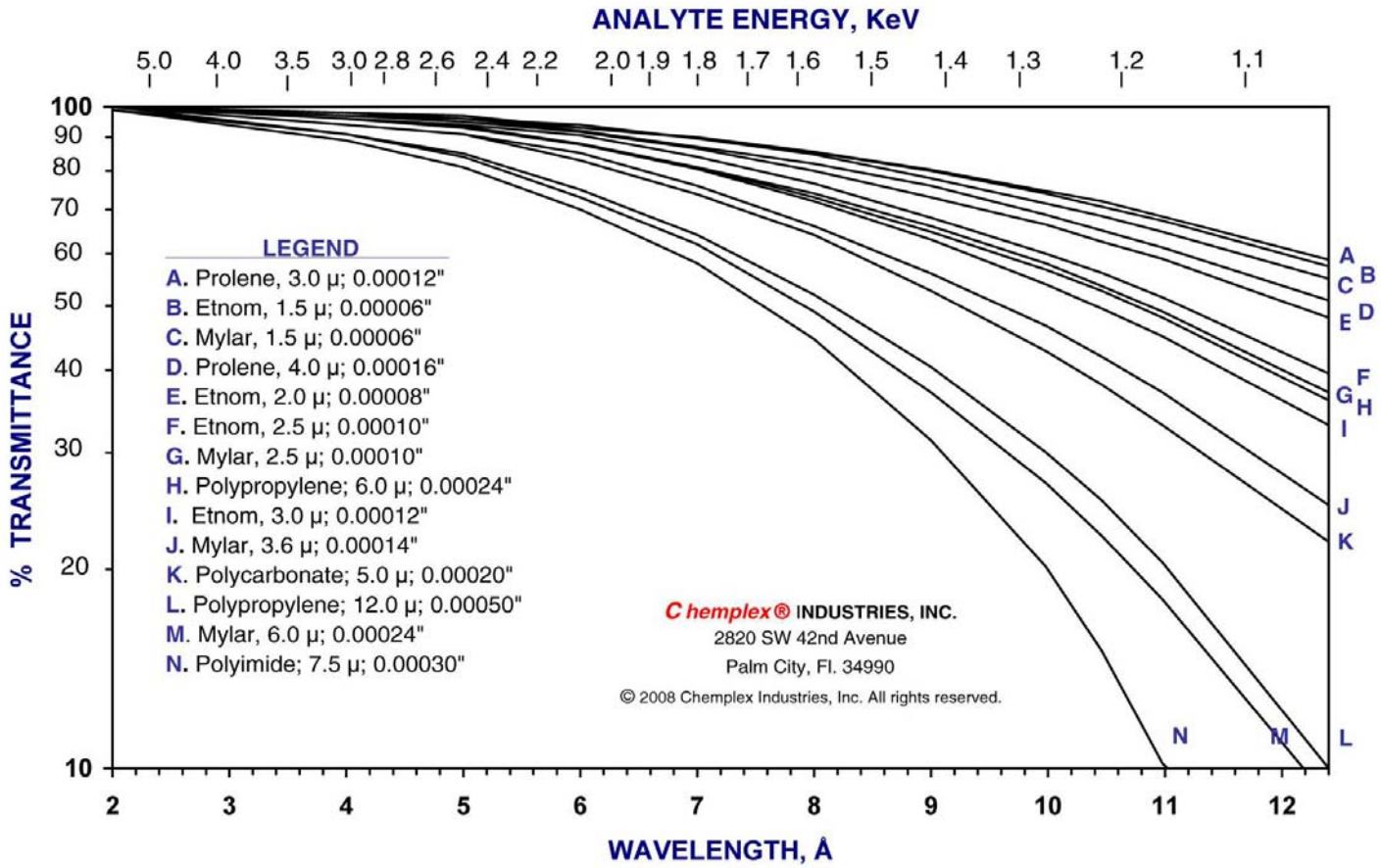
2. TRANSMITTANCE OF SPECTRAL LINES

The transmittance properties of a thin-film are functions of gauge thickness, density and mass attenuation coefficients of the constituent chemical elements in accordance with the following formula:

$$I / I_o = \exp [-(\mu/d)\ (d)]$$

Where, Io = percent transmitted spectral line energy
μ/d = mass attenuation coefficient
dt = area concentration

The following graphic representation of the above formula is the most frequently used visual aid in comparing % Transmittance values of various thin-film substances and gauges. Simply refer the spectral line of the element in the sample of analytical interest having the lowest energy, KeV, (or shortest wavelength, Ångstrom, Á) to each of the curves representing thin-film materials and gauges. Compare their transmittance percentages and select the thin-film offering the highest % Transmittance value.



3. CHEMICAL RESISTANCE

In conjunction with selecting a thin-film providing a high % Transmittance value, evaluate the resistance of a thin-film sample support substance to chemical attack by a sample material from the following table. Liquid sample substances are more prone to degrading a thin-film than solids.

RESISTANCE OF THIN-FILM SUBSTANCES TO CHEMICAL ATTACK

CHEMICAL SAMPLE	POLYESTER (MYLAR ®)	POLYCARBONATE	ETNOM®	POLYPROPYLENE	POLYIMIDE (KAPTON®)	PROLENE®	ULTRA-POLYESTER™
Acid, dilute or weak	G	G	G	E	N	G	G
Acids, conc.	G	G	G	E	N	E	G
Alcohols, aliphatic	N	G	G	E	G	E	N
Aldehydes	U	F	F	E	E	E	U
Alkalies, conc.	N	N	G	E	E	E	N
Esters	N	N	F	G	G	G	N
Ethers	F	N	F	N	U	N	F
Aliphatic Hydrocarbon	G	N	E	G	E	G	G
AromaticHydrocarbon	N	N	E	N	E	N	N
Halogenated Hydrocarbon	F	N	F	N	F	N	F
Ketones	N	N	G	G	G	G	N
Oxidizing agents	F	N	F	F	N	F	F

E=**Excellent**, G=**Good**, F=Fair, N=Not recommended, U=Unknown

IMPORTANT: The chemical resistances of thin-films contained in the above table are provided as a matter of information purpose only and they are not intended to preclude actual testing and suitability of use and applications. The responsibility of acceptance and safety resides totally with the user.

IMPORTANT: Some window materials may not be suitable for analyzing sulfur in diesel fuel, gasoline and other petroleum products containing aromatic hydrocarbons. ASTM D-6445-99 (Reapproved 2004) e1: "**Samples of high aromatic content may dissolve polyester and polycarbonate films**. In these cases, other materials besides these films may be used for X-ray windows, provided that they do not contain any elemental impurities. An optional window material is polyimide film. While polyimide film absorbs sulfur x-rays more than other films, it may be a preferred window material as it is much more resistant to chemical attack by aromatics and exhibits higher mechanical strength." ASTM D 4294-08a: "Any film that resists attack by the sample, is free of sulfur, and is sufficiently X-ray transparent can be used. Film types can include polyester, polypropylene, polycarbonate, and polyimide. **However, samples of high aromatic content can dissolve polypropylene, polycarbonate and polyester."**