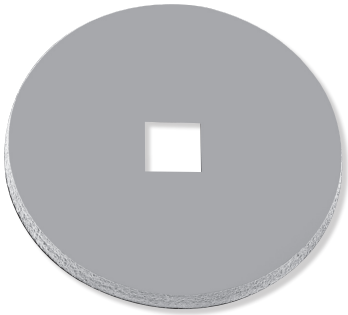
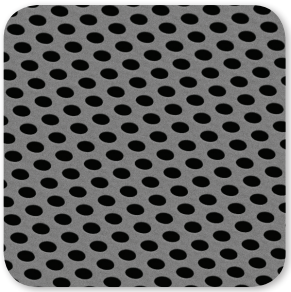
PELCO® SILICON NITRIDE, SILICON DIOXIDE, BLANK SILICON SUBSTRATES & APERTURES FOR TEM

Clean, Debris-free with Exact 3mm TEM Frame and EasyGrip™ Edges

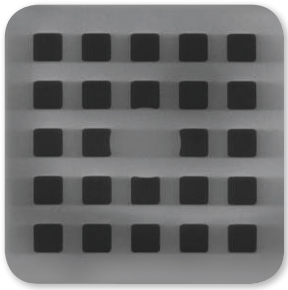
PELCO® Silicon Nitride Support Films for TEM



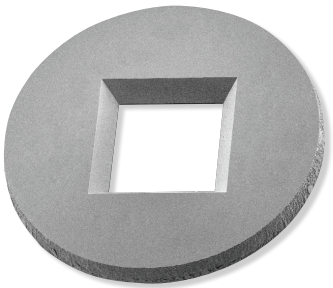
Hydrophilic / Hydrophobic SiN Support Films



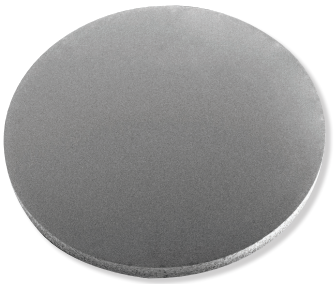
PELCO® Holey Silicon Nitride Support Films for TEM



PELCO® Silicon Dioxide Support Films for TEM



Silicon Aperture Frames (without support films)



Silicon Nitride Coated & Blank 3mm Si Discs

The PELCO® Silicon Nitride Support Films for TEM (also called Si_3N_4 TEM membranes) have been developed as an addition to our extensive range of TEM support films to further enable nanotechnology applications and extend molecular biology research. These superior products are made by state-of-the-art semiconductor and patented MEMS fabrication techniques using resilient, low-stress inorganic and amorphous silicon nitride thin films supported by a sturdy silicon frame. PELCO® Silicon Nitride Support Films are available in four window sizes combined with either 8, 15, 35, 50 or 200nm thin membrane thickness on an EM industry standard 3mm diameter round frame, making them the most desirable and useful silicon nitride support films in the current marketplace.

PELCO® Silicon Nitride Support Films have the advantages of being chemically and mechanically robust and can withstand temperature changes up to 1000°C. They are extremely stable and suitable to conduct a variety of nanotechnology experiments with particles or cells mounted directly on the support films.

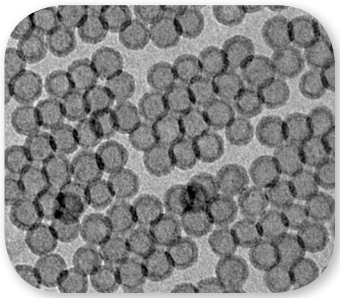
PELCO® Silicon Nitride Support Films are indispensable tools for virtually all fields of nanotechnology research. They enable direct deposition and *in situ* observations of dynamic reactions over a wide temperature range. The support film can be used as a passive support film but can also play a role as an active participant in experiments.

Hydrophobic and Hydrophilic Substrates have been added for nanotechnology and biotechnology applications. The ultra-low-stress 15nm, 50nm, and 200nm membranes have been Atomic Layer-Deposited (ALD) to create these surfaces. PELCO® Silicon Nitride Support Films are manufactured using state-of-the-art semiconductor and MEMS manufacturing techniques. The amorphous PELCO® Silicon Nitride Support Film is grown on a silicon wafer to the desired membrane

Continued next page...

PELCO® SILICON NITRIDE & SILICON DIOXIDE SUPPORT FILMS

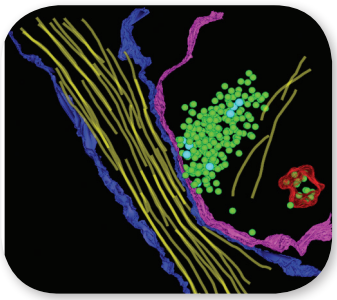
thickness of 8, 15, 35, 50, or 200nm. The specimen viewing area is created by etching away a window in the silicon substrate, leaving a smooth, resilient and chemically robust silicon nitride film. The frame is manufactured as a 3mm silicon disc with smooth EasyGrip™ edges for easy manipulation by tweezers and will fit perfectly in standard TEM holders. Standard thickness of the silicon frame is 200µm, which will fit most TEM holders. A special version with a 50µm thickness and a 0.25 x 0.25mm window is available for special TEM holders that only accommodate thinner supports. Easier handling capabilities and smoothness of the edges are design advantages over other brands of silicon nitride support films. The PELCO® Silicon Nitride Support Films are manufactured like grids and are free from debris particles. The mechanical and chemical stability allow for cleaning of the PELCO® Silicon Nitride Support Films with chemicals (solvents, acids and bases), glow discharge and plasma cleaning. It is recommended that ultrasonic cleaning not be used, as it can easily shatter the PELCO® Silicon Nitride Support Films.



Iron nanoparticles dispersed on a SiN support film and oxidized at 350°C while supported on the PELCO® SiN support films. Haitao Liu, Dept. of Chemistry, UC Berkeley, California

Applications Fields

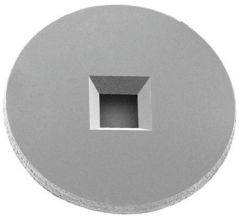
- Cell biology: attached cells can be grown in their environment on the support film and subsequently analyzed
- Analysis of colloids, aerosols and nanoparticles
- Self-assembled mono-layers
- Polymer research
- Thin film research can be directly deposited on the PELCO® Silicon Nitride Support Film
- Materials science
- Properties of nano-structures for semiconductor devices
- Semiconductor: characterization of thin films
- Catalyst development



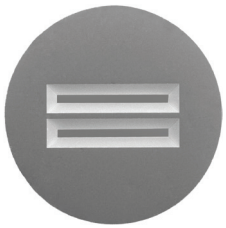
Three-dimensional model of tomographic data created by the use of the IMOD suite of programs. Prof. M. Stowell, et. al., MCDB, CU-Boulder, Colorado

Specifications for the PELCO® Silicon Nitride Support Films

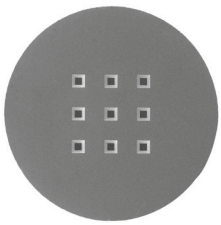
- Film Thickness: resilient, ultra-low-stress 8, 15, 35 or 50nm, with minimum absorption to enable clear imaging; robust low-stress 200nm for better handling and use on multiple platforms
- Window Sizes: 0.25 x 0.25mm, 0.5 x 0.5mm, 0.75 x 0.75mm, 1.0 x 1.0mm, 0.5 x 1.5mm; multiple window versions with 9 windows of 0.1 x 0.1mm in a 3 x 3 array or 2 windows of 0.1 x 1.5mm. Larger windows give a greater viewing area and allow for the higher tilt angles required for tomography applications. The versions with multiple windows allow for mounting multiple samples in separate windows on the same support film.
- Window /Aperture Size for Ultra-Thin, 8nm Film: Window size is 0.5 x 0.5mm with 25 apertures of 60 x 60µm on a 200nm silicon nitride support mesh. Bar width is 35µm, edge is 30µm.
- Window / Aperture Size for Resilient 35nm Film: Window size is 0.5 x 0.5mm with 25 apertures of 70 x 70µm on a 200nm support mesh. Bar width is 25µm, edge is 25µm.
- Frame Thickness: Silicon support structure is 200µm standard. This allows for fitting in all standard TEM holders and gives a sturdy support to the frame. 50µm is also available for special TEM holders.
- Surface Roughness: The RMS (Rq) is 0.65 ± 0.06nm, which gives a mean roughness (Ra) of 0.45 ± 0.02nm
- Frame Diameter: EM standard Ø3mm disc, fully compatible with TEM holders and with EasyGrip™ edges for improved handling
- Packaging: PELCO® Silicon Nitride Support Films are packaged under cleanroom conditions in the PELCO® #160 TEM Grid Storage Box, 10 support films per box.



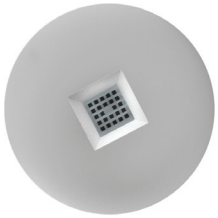
Single Windows



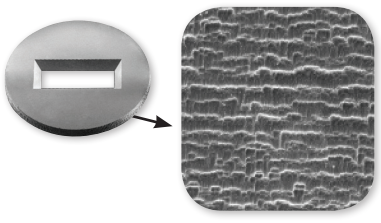
2 ea. 0.1 x 01.5mm Apertures



9 ea. 0.1 x 0.1mm Apertures



Ultra-thin 8nm



EasyGrip™ Edge for Improved Handling

PELCO® Si_3N_4 Support Films Ordering Information

8nm Membrane Thickness / 25 Apertures / 200µm Frame Thickness

21510-10 8nm, 60 x 60µm Apertures (25) on 0.5 x 0.5mm Window....pkg/10

15nm Membrane Thickness / 200µm Frame Thickness

21560-10 15nm with 0.25 x 0.25mm Window.....pkg/10

21569-10 15nm with 9 each 0.1 x 0.1mm Windows.....pkg/10

35nm Membrane Thickness / 25 Apertures / 200µm Frame Thickness

21515-10 35nm, 70 x 70µm Apertures (25) on 0.5 x 0.5mm Window ... pkg/10

50nm Membrane Thickness / 200µm Frame Thickness

21505-10 50nm with 0.25 x 0.25mm Window.....pkg/10

21505-100 50nm with 0.25 x 0.25mm Window.....pkg/100

21500-10 50nm with 0.5 x 0.5mm Window.....pkg/10

21500-100 50nm with 0.5 x 0.5mm Window.....pkg/100

21501-10 50nm with 0.75 x 0.75mm Window.....pkg/10

21501-100 50nm with 0.75 x 0.75mm Window.....pkg/100

21502-10 50nm with 1.0 x 1.0mm Window.....pkg/10

21502-100 50nm with 1.0 x 1.0mm Window.....pkg/100

21504-10 50nm with 0.5 x 1.5mm Window.....pkg/10

21504-100 50nm with 0.5 x 1.5mm Window.....pkg/100

21508-10 50nm with 2 each 0.1 x 1.5mm Windows.....pkg/10

21509-10 50nm with 9 each of 0.1 x 0.1mm Windows pkg/10

200nm Membrane Thickness / 200µm Frame Thickness

21525-10 200nm with 0.25 x 0.25mm Window.....pkg/10

21525-100 200nm with 0.25 x 0.25mm Window.....pkg/100

21520-10 200nm with 0.5 x 0.5mm Window.....pkg/10

21520-100 200nm with 0.5 x 0.5mm Window.....pkg/100

21521-10 200nm with 0.75 x 0.75mm Window.....pkg/10

21521-100 200nm with 0.75 x 0.75mm Window.....pkg/100

21522-10 200nm with 1.0 x 1.0mm Window.....pkg/10

21522-100 200nm with 1.0 x 1.0mm Window.....pkg/100

21524-10 200nm with 0.5 x 1.5mm Window.....pkg/10

21524-100 200nm with 0.5 x 1.5mm Window.....pkg/100

21528-10 200nm with 2 each 0.1 x 1.5mm Windows.....pkg/10

21529-10 200nm with 9 each 0.1 x 0.1mm Windows.....pkg/10

50nm Membrane Thickness / 50µm Frame Thickness

21570-10 50nm on 50µm Frame Thickness w/ 0.25 x 0.25mm Window..pkg/10

21578-10 50nm on 50µm Frame Thickness w/ 2 each 0.1 x 1.5mm Windows.....pkg/10

21579-10 50nm on 50µm Frame Thickness w/ 9 each 0.1 x 0.1mm Windows.....pkg/10

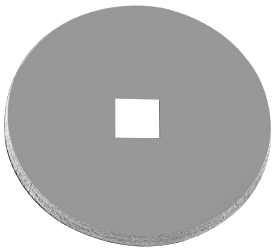
SILICON NITRIDE ASSORTMENT PACK

The Silicon Nitride Assortment Pack is the ideal way to determine which membrane thickness or size of silicon nitride or silicon dioxide is the optimum product for your application. The assortment pack includes the following thickness and window sizes on 200µm thick silicon frames:

Position	Unit	Membrane Type
1A	1 ea.	Si_3N_4 15nm Membrane w/ 0.25 x 0.25mm Window
1B	1 ea.	Si_3N_4 15nm Membrane w/ 0.25 x 0.25mm Window
1C	1 ea.	Si_3N_4 50nm Membrane w/ 0.25 x 0.25mm Window
1D	1 ea.	Si_3N_4 50nm Membrane w/9 ea. 0.1 x 0.1 Windows
1E	1 ea.	Si_3N_4 50nm Membrane w/ 0.5 x 0.5mm Window
2A	1 ea.	Si_3N_4 50nm Membrane w/ 0.75 x 0.75mm Window
2B	1 ea.	Si_3N_4 200nm Membrane w/ 0.25 x 0.25mm Window
2C	1 ea.	Si_3N_4 200nm Membrane w/ 0.5 x 0.5mm Window
2D	1 ea.	SiO_2 40nm Membrane w/ 0.5 x 0.5mm Window
2E	1 ea.	Holey Si_3N_4 200nm Membrane, 2.5µm Holes w/ 0.5 x 0.5mm Window

PELCO® Si_3N_4 Assortment Pack Ordering Information

21597-10 Silicon Nitride Assortment Pack. 10 different membranes



PELCO® HYDROPHOBIC & HYDROPHILIC Si_3N_4 MEMBRANE SURFACES

Silicon Nitride membranes have been modified using Atomic Layer-Deposited (ALD) techniques to change their surface properties.

Depending on the process used, both hydrophilic and hydrophobic substrates have been created with the following advantages:

- Choice between low and high surface energies
- Smooth and conformal substrates
- Enhanced wetting and biocompatibility (hydrophilic)
- No need for plasma treatment of surface prior to cell growth
- Hydrophobic coating offers novel platform for deposition and growth of nanomaterials

Both coatings are available on 50nm and 200nm Silicon Nitride Membranes with a 0.5 x 0.5mm window and 15nm Si_3N_4 membrane with 9 each 0.1 x 0.1nm windows on a 200µm silicon frame with a diameter of 3mm, compatible with all standard TEM grid holders. Both sides of the membrane and frame are coated. We advise handling the discs by gripping at the edge.

Specifications for the PELCO® Hydrophobic & Hydrophilic Si_3N_4 Membrane Surfaces

- Hydrophilic: 2.5nm atomic layer-deposited hydroxylated alumina on 15, 50 and 200nm ultra-low-stress silicon nitride membranes
- Hydrophobic: 2.5nm atomic layer-deposited alumina and fluoro-methyl-silane on 15, 50 and 200nm ultra-low-stress silicon nitride membrane
- Surface Energy:

Surface	Surface Energy	Stndrd. Deviation
Si_3N_4 Membrane	46.1 mJ/m²	4.3
Hydrophilic Coating	75.1 mJ/m²	2.2
Hydrophobic Coating	24.6 mJ/m²	4.4

mJ = millijoules

- Surface Roughness:

Surface	Surface Roughnesss	Stndrd. Deviation
Si_3N_4 Membrane	Rq=0.65 Ra=0.45	0.06 0.02
Hydrophilic Coating	Rq=0.57 Ra=0.40	0.04 0.03
Hydrophobic Coating	Rq=0.66 Ra=0.40	0.03 0.05

Rq = surface roughness
Ra = roughness average

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PELCO® SILICON NITRIDE & SILICON DIOXIDE SUPPORT FILMS

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- Film Thickness: Resilient, low-stress 15, 50 and 200nm, minimum absorption to enable clear imaging
- Window Sizes: Array of 9 each 0.1 x 0.1mm and 0.5 x 0.5mm
- Frame Thickness: Silicon support structure is 200µm standard
- Frame Diameter: EM standard 3mm diameter disc, fully compatible with standard TEM holders (no broken edges)
- EasyGrip™ edges for easy handling with tweezers
- Packaging: Packaged under cleanroom conditions in the PELCO® #160 TEM Grid Storage Box. 10 support films per box.

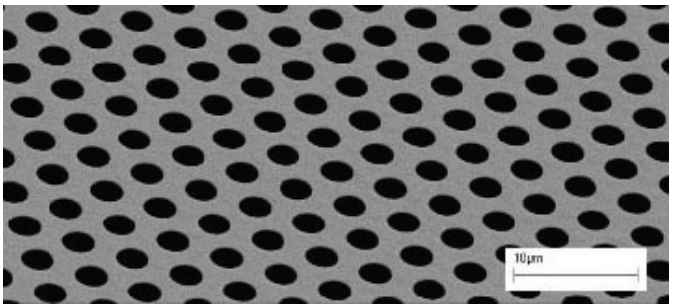
PELCO® Hydrophilic & Hydrophobic Si_3N_4 Membranes Ordering Information

Hydrophilic Si_3N_4 Membranes

21553-10 15nm, 9 each 0.1 x 0.1mm Windows pkg/10
21550-10 50nm, 0.5 x 0.5mm Window pkg/10
21551-10 200nm, 0.5 x 0.5mm Window pkg/10

Hydrophobic Si_3N_4 Membranes

21593-10 15nm, 9 each 0.1 x 0.1mm Windows pkg/10
21552-10 50nm, 0.5 x 0.5mm Window pkg/10
21591-10 200nm, 0.5 x 0.5mm Window pkg/10



PELCO® HOLEY Si_3N_4 SUPPORT FILM FOR TEM

200nm Membrane with Holes from 2.5µm Down to 100nm

Advanced MEMs technologies have been applied to incorporate many improvements into this truly unique next generation holey silicon nitride support membrane. Holey membranes or support films are also referred to as perforated or patterned films; there is no film or membrane covering the holes. The platform for this Holey Silicon Nitride support film is the low stress 200nm amorphous Silicon Nitride support film on a circular 3mm silicon frame with a 0.5 x 0.5mm membrane. The diameter of the holes available is 2.5µm, 1.25µm, 1µm, 750nm, 500nm, 400nm, and 100nm.

This Design Has Numerous Advantages Over Previously Offered Products

- Relatively large open area
- Added resilience of membrane
- A variety of hole sizes for different experiments
- A boundary of 25µm non-perforated membrane surrounding the holey membrane area
- TEM standard circular shape
- EasyGrip™ edge for improved handling

The PELCO® Silicon Nitride Support Films are resistant to solvents, acids and bases, allowing for dynamic experiments directly on the holey membrane. These Holey Silicon Nitride Support Films allow for high temperature experiments/ imaging up to 1000°C. Films can be easily cleaned using glow discharge or plasma cleaning techniques. In addition they also provide a carbon-free background for TEM imaging and analysis. The clean manufacturing techniques avoid the debris particles that are often found on other makes of silicon nitride support films.

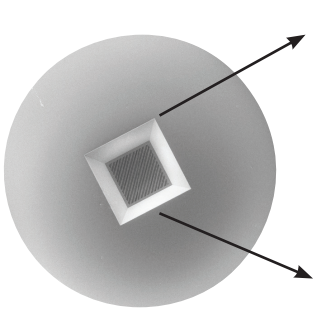
Specifications for the PELCO® Holey Si_3N_4 Support Films

- Membrane Thickness: 200nm for added resilience
- Window Size: 0.5 x 0.5mm
- Hole Sizes and Pitch:

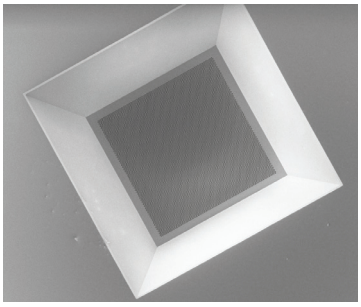
Hole Size (nm)	Pitch (µm)	Array	Array Area (µm)
5000	10.0	45 x 45	450 x 450
2500	5.0	90 x 90	450 x 450
1250	2.5	180 x 180	450 x 450
1000	2.0	225 x 225	450 x 450
750	1.5	300 x 300	450 x 450
500	1.0	450 x 450	450 x 450
400	0.80	562 x 562	450 x 450
100	0.20	375 x 375	75 x 75

See http://www.tedpella.com/grids_html/silicon-nitride-holey.htm for new additions to the line of Si3N4 support films in the following pore sizes within a 450 x 450µm array area: 5000nm, 300nm, 250nm, 200nm and 150nm.

- Pore Diameter: Sizes are within 10% of diameter
- Pattern: Close packed hexagonal arrangement of 100 x 100 rows/columns with a total of 10,000 holes for the 2.5µm pores. A 25µm boundary of non-perforated membrane surrounds the perforated area.
- Perforated Area: 0.45 x 0.45mm for all pore sizes except 100nm
- Frame Thickness: Silicon support structure is 200µm standard. This allows for fitting in standard TEM holders and gives a sturdy support frame.
- Surface Roughness: The RMS (Rq) is 0.65 ± 0.06nm which gives a mean roughness (Ra) of 0.45 ± 0.02nm
- Frame Diameter: TEM standard 3mm diameter disc, fully compatible with regular TEM holders and with Easy Grip™ edges for improved handling
- Packaging: Packaged under cleanroom conditions in the PELCO® #160 TEM Grid Storage Box. 10 support films per box.



Holey 200nm Silicon Support Frame on 3mm Frame



0.5 x 0.5mm Window with Holey Silicon Nitride Membrane Imaged from Back Side

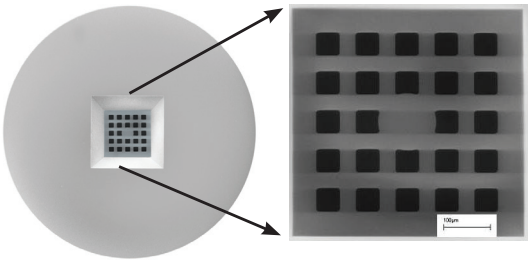
PELCO® Holey Si_3N_4 Support Film Ordering Information

21535-10	200nm, 2.5µm Pores, 0.5 x 0.5mm Window	pkg/10
21580-10	200nm, 1.25µm Pores, 0.5 x 0.5mm Window	pkg/10
21581-10	200nm, 1.0µm Pores, 0.5 x 0.5mm Window	pkg/10
21582-10	200nm, 750nm Pores, 0.5 x 0.5mm Window	pkg/10
21583-10	200nm, 500nm Pores, 0.5 x 0.5mm Window	pkg/10
21584-10	200nm, 400nm Pores, 0.5 x 0.5mm Window	pkg/10
21585-10	200nm, 100nm Pores, 0.5 x 0.5mm Window	pkg/10
21589-10	200nm, Multiple Pore Sizes (1000, 750, 500, 400, 350 and 300nm), 0.5 x 0.5mm Window, Ø3mm	pkg/10

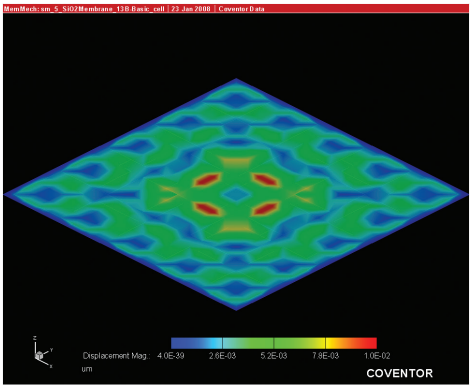
See http://www.tedpella.com/grids_html/silicon-nitride-holey.htm for new additions to the line for the following pore sizes in 0.5 x 0.5mm windows: 5µm, 300nm, 250nm, 200nm & 150nm

PELCO® SILICON DIOXIDE SUPPORT FILM FOR TEM

Ultra-flat, 40, 18 and 8nm Membrane Thickness

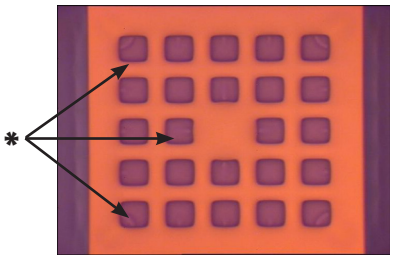


These PELCO® membranes of Silicon Dioxide (SiO_2) offer superior flatness. Using advanced MEMS manufacturing technologies combined with novel stress-reducing techniques, we have been able to provide Silicon Dioxide Support Films with unsurpassed flatness and a membrane thickness of 40nm, 18nm and 8nm. It is truly the next generation Silicon Dioxide membranes. The flatness of our silicon dioxide membranes is at least 10x better than competitive products. The SiO_2 membranes are completely amorphous.



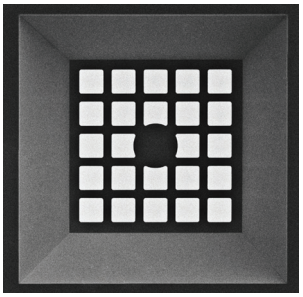
Presentation of film flatness using a simulation for the displacement of SiO2 membrane versus x-y position on the 0.5mm x 0.5mm window.

The Silicon Dioxide (SiO_2) Support Films are manufactured using the PELCO® 200nm Silicon Nitride (Si_3N_4) Support Films with the 0.5 x 0.5mm window on a perfectly round 3mm Si frame as a platform. The silicon dioxide support films consist of pure and amorphous thermal SiO_2 membrane. The 0.5 x 0.5mm membrane is patterned into 24 ea. apertures with a size varying between 50 x 50µm to 70 x 70µm and etched back to the thermally-



Optical Image Showing
**Areas with Only Minor Distortion*

deposited amporhous Silicon Dioxide leaving a structure-free SiO_2 thin membrane of 40nm, 18nm or 8nm, suspended by a 200nm optically transparent (Si_3N_4) support mesh. The bar size between the SiO_2 apertures is 25 - 35µm and the boundary width is 25 - 55µm. The design of the mesh and the ratio of mesh suspension and Silicon Dioxide Film has been optimized to enable flat Silicon Dioxide Support Films with a size of 50 x 50µm to 70 x 70µm. The result is a Silicon Dioxide membrane with a truly superior flatness, ideal for TEM imaging. In the unique design of this PELCO® product, the compression in the SiO_2 film is balanced by the stress in the Si_3N_4 grid structure. The mesh size of the PELCO® Silicon Dioxide Support Films is comparable to the area size found on most 300 and 400 mesh TEM grids and is considered to be a practical size for many applications. There are 24 fields of SiO_2 support films on each frame. The boundary of 200nm Si_3N_4 membrane leaves ample area for experiments on Si_3N_4.



8mm SiO_2 Support

Thermal Silicon Dioxide is one of most functionalized surfaces in analytical chemistry and can be used as a platform to study base materials and biological entities. The support films can be either used as a passive physical support for TEM imaging or as an active participant in experiments. The Silicon Dioxide Support Films have excellent chemical, physical and thermal stability. Properties can be modified or enhanced by coatings, or properties of thin films can be studied by direct deposition on the Silicon Dioxide Film. The 8nm thin SiO_2 membranes are resilient enough to allow for manufacturing custom-made holes by using FIB.

Examples of Applications

- Nanomaterial deposition and growth
- Thin film analysis and characterization
- Catalyst research and development
- Support for FIB lamellae
- Characterization of semiconductor materials
- Study of attached biological molecules

Specifications for the PELCO® Silicon Dioxide Support Films

- Membrane Thickness: 40nm, 18nm and 8nm
- Aperture Size/Number: 50 x 50µm / 24 apertures for 40nm, 60 x 60µm / 24 apertures for 18nm, and 70 x 70µm / 24 apertures for 8nm
- Pattern: 5 rows x 5 columns with 200nm Si_3N_4 grid support structure, 35µm bar and 55µm edge for 40nm, 35µm bar and 30µm edge for 18nm, and 25µm bar and 25µm edge for 8nm

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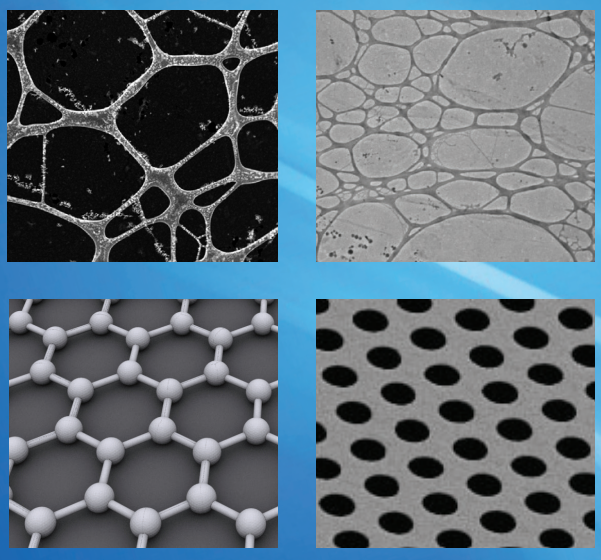
PELCO® SILICON DIOXIDE SUPPORT FILMS & APERTURES

...continued from previous page.

- Total Window Area: 0.5 x 0.5mm
- Frame Thickness: Silicon support structure is 200µm standard. This allows for fitting in standard TEM holders and gives a sturdy support frame
- Surface Roughness: the RMS (Rq) is 0.65nm which gives a mean roughness (Ra) of 0.41nm
- Frame Diameter: TEM standard 3mm disc, fully compatible with regular TEM holders and with EasyGrip™ edges for improved handling
- Packaging: Packaged under cleanroom conditions in the PELCO® #160 TEM Grid Storage Box. Each box holds 10 support films.

PELCO® Silicon Dioxide Support Films Ordering Information

21532-10	8nm, 70 x 70µm Apertures (24) on 0.5 x 0.5mm Window, Ø3mm	pkg/10
21531-10	18nm, 60 x 60µm Apertures (24) on 0.5 x 0.5mm Window, Ø3mm	pkg/10
21530-10	40nm, 50 x 50µm Apertures (24) on 0.5 x 0.5mm Window, Ø3mm	pkg/10

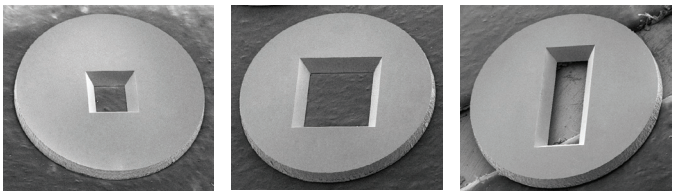


PELCO® GRAPHENE & GRAPHENE OXIDE TEM SUPPORT FILMS AT:

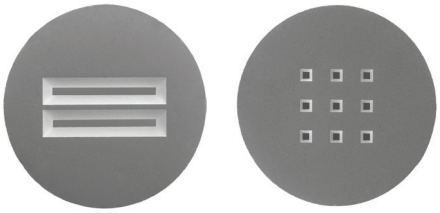
www.tedpella.com

PELCO® SILICON APERTURE FRAMES

Without Support Film



0.5 x 0.5mm *1.0 x 1.0mm* *1.5 x 0.5mm*



2 ea. 1.0 x 1.5mm *9 ea. 0.01 x 0.1mm*

The PELCO® Silicon Aperture Frames are 3mm disc-type frames with a thickness of 200µm and square or rectangular apertures. They are useful for a variety of applications.

Application Examples

- Support frame to attach TEM lamellae made with FIB
- Support frame for thin films, foils, wires and fibers
- Mask for thin film research (deposition mask)

Specifications for the PELCO® Silicon Aperture Frames

- Single Aperture Opening Sizes: 0.25 x 0.25mm, 0.5 x 0.5mm, 0.75 x 0.75mm, 1 x 1mm, 0.5 x 1.5mm
- Multiple Aperture Opening Sizes: 9 windows of 0.1 x 0.1mm in a 3 x 3 array or 2 windows of 0.1 x 1.5mm
- Window Side Angle: 35.26°
- Aperture Frame Thickness: 200µm
- Aperture Frame Diameter: 3mm
- Aperture Material: Si
- Surface: Top side Si, back side (larger opening) has 50nm layer of Si_3N_4
- Packaging: Packaged under cleanroom conditions in a small vial holding 10 discs

PELCO® Silicon Aperture Frames Ordering Information

21545-10	0.25 x 0.25mm	vial/10
21540-10	0.5 x 0.5mm	vial/10
21543-10	0.75 x 0.75mm	vial/10
21541-10	1.0 x 1.0mm	vial/10
21542-10	0.5 x 1.5mm	vial/10
21548-10	2 each 0.1 x 1.5mm	vial/10
21549-10	9 each 0.1 x 0.1mm	vial/10

PELCO® SILICON NITRIDE COATED & SILICON Ø3mm DISCS (BLANKS)

These 3mm Silicon discs have an ultra-flat (Ra 0.45 ± 0.2nm) 50nm ultra-low-stress Silicon Nitride layer on both sides. Also available with a hydrophilic or hydrophobic surface coating or just as a silicon disk. The disks are made with the same state-of-the-art manufacturing techniques as the PELCO® Silicon Nitride Support Films. The disks are perfectly round and have the Easygrip™ edge for easy handling. Clean surface, no broken edges and free of debris often associated with other manufacturing processes. The ultra-low-stress film is non-stoichiometric and closer to SiN than Si_3N_4. They can be used for a number of applications.

Application Examples

- Specimen mounts for SEM and FESEM applications
- Specimen discs for AFM applications
- Blanks to build the PELCO® Liquid Cell™ together with the PELCO® Silicon Nitride Membrane

Specifications for the PELCO® Silicon Nitride Coated & Silicon Ø3mm Discs

- Film Thickness: 50nm ultra-low-stress silicon nitride on both sides
- Hydrophilic: 5nm atomic layer-deposited hydroxylated alumina on 50nm ultra-low-stress silicon nitride
- Hydrophobic: 5nm atomic layer-deposited alumina and fluoro-methylsilane on ultra-low-stress silicon nitride
- Disc Thickness: 200µm silicon support
- Disc Diameter: 3mm
- Surface Roughness: The RMS (Rq) is 0.65 ± 0.06nm which gives a mean roughness (Ra) of 0.45 ± 0.02nm
- Packaging: Discs with hydrophilic or hydrophobic coating are packaged under cleanroom conditions in the PELCO® #160 Grid Storage Box. Each box holds 10 discs. Other discs are packaged in a vial holding 10 discs.

PELCO® Silicon Nitride Coated & Silicon Ø3mm Discs Ordering Information

21555-10	PELCO® Silicon Nitride Coated Discs, Ø3mm	vial/10
21556-10	PELCO® Silicon Nitride Coated Discs w/ Hydrophilic Coating, Ø3mm	pkg/10
21557-10	PELCO® Silicon Nitride Coated Discs w/ Hydrophobic Coating, Ø3mm	pkg/10
21558-10	PELCO® Silicon Nitride Discs, Ø3mm, No Coating	vial/10

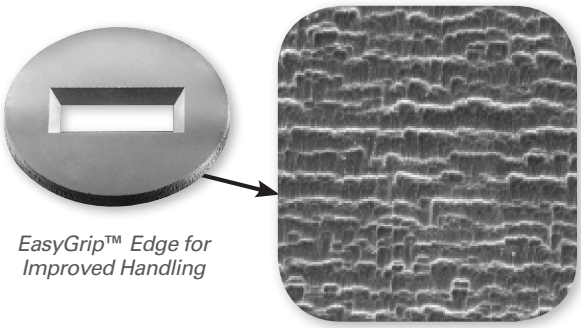
PELCO® SILICON NITRIDE SUPPORT FILMS FOR TEM - MANUFACTURING DETAILS

Manufacturing Method

Silicon nitride support films are manufactured using the latest, patented, state-of-the-art semiconductor and MEMS techniques. The thin amorphous silicon nitride film is grown on a 200µm thick silicon wafer to the desired membrane thickness of 8, 15, 35, 50 or 20nm. The specimen viewing area is created by etching away a window in the silicon wafer substrate underneath the Si_3N_4 membrane, leaving a perfectly smooth, resilient and chemically robust silicon nitride film. The membrane is not supported in the window area, enabling large viewing areas without any disturbing bars. After finishing the window etching process, the individual frames with the membranes are lifted from the wafer. Wafers used are P-type (B doped) with a resistivity or 2-15 ohm-cm.

Frame Dimensions

The frame is manufactured as a 3mm silicon disc with smooth EasyGrip™ edges for easy manipulations by tweezers and will fit perfectly in standard TEM holders. The standard frame thickness of 200µm is more than the typical TEM grid with a thickness of 15-50µm, but should not present a problem in regular TEM holders. It is recommended that you check the TEM holders you are using. For special TEM holders, versions with 50µm frame thickness are available. 50µm frame thickness is compatible with any Ø3mm TEM holder.



EasyGrip™ Edge for Improved Handling

Window Sizes & Shapes

- Five single widow sizes are available:
  - 0.25 x 0.25mm, most robust membrane and most cost effective
  - 0.5 x 0.5mm, sturdy and less cost effective
  - 0.75 x 0.75mm, less fragile, relatively large membrane
  - 1 x 1mm, larger area, but more fragile
  - 1.5 x 0.5mm, resilient for large viewing area or tomography
- Two multiple window sizes available:
  - 2 each 0.1 x 1.5mm, rectangular window
  - 3 x 3 array of 0.1 x 0.1mm window
- Window with apertures for 8 and 35nm:
  - 200nm silicon nitride support mesh
  - 25 each 60 x 60µm apertures with 8nm membrane
  - 25 each 70 x 70µm apertures with 35nm membrane
  - Total window size 0.5 x 0.5mm

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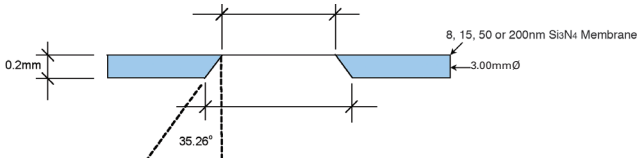
PELCO® SILICON NITRIDE & SILICON DIOXIDE SUPPORT FILMS FOR TEM

PELCO® SILICON NITRIDE SUPPORT FILMS FOR TEM - MANUFACTURING DETAILS

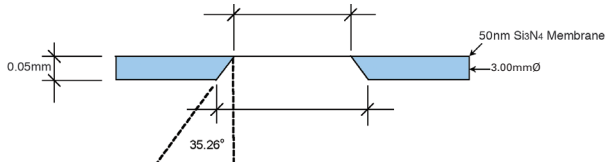
Due to the structure of the silicon and the etching process the window in the silicon substrate is etched with a 35° angle, leaving a much larger opening than the membrane window at the back side of the frame.

Table 1. Window Dimensions on Standard 200µm Frame Thickness



X Dimensions (mm)	Y Dimensions (mm)	Area (mm²)	Membrane Thickness (nm)	X Back Side Opening (mm)	Y Back Side Opening (mm)
0.25	0.25	0.06	15/50/200	0.53	0.53
0.5	0.5	0.25	50/200	0.78	0.78
0.75	0.75	0.56	50/200	1.03	1.03
1	1	1	50/200	1.28	1.28
1.5	0.5	0.75	50/200	1.78	0.78
1.5	0.1	2 x 0.15	15/50/200	1.78	0.38
0.1	0.1	9 x 0.01	15/50/200	0.38	0.38
0.5	0.5	0.09 for 8nm	8	0.78	0.78
0.5	0.5	0.12 for 35nm	35	0.78	0.78

Table 2. Window Dimensions on Special 50µm Thin Frame Version



X Dimensions (mm)	Y Dimensions (mm)	Area (mm²)	Membrane Thickness (nm)	X Back Side Opening (mm)	Y Back Side Opening (mm)
0.25	0.25	0.06	50	0.32	0.32
1.5	0.1	2 x 0.15	50	1.57	0.17
0.1	0.1	9 x 0.1	50	0.17	0.17

Debris-Free Products

Handling capabilities and smoothness of the edges are design advantages over other brands of silicon nitride support films. The PELCO® Silicon Nitride Support Films are manufactured like TEM grids with a 3mm diameter using a unique and patented manufacturing process. They have no broken edges, are circular and are completely free from debris particles, unlike other brands of silicon nitride membranes. The mechanical and chemical stability allows for cleaning or treating of the silicon nitride support films with chemicals (solvents, acids and bases), glow discharge and plasma cleaning. It is recommended that ultrasonic cleaning not be used, as it can easily shatter the silicon nitride support films.

Manufacturing Tolerances

- Frame Thickness: 200µm ±15µm
  50µm ±10µm
- Membrane Thickness: 200nm ±10nm
  50nm ±5nm
  35nm ±4nm
  15nm ±3nm
  8nm ±2nm
- Frame Diameter: 3.0mm ±0.05mm
- Window Dimensions: 0.1 x 0.1mm (9) ±5µm
  0.25 x 0.25mm - 250µm ±10µm
  0.5 x 0.5mm - 500µm ±20µm
  0.75 x 0.75 - 750µm ±25µm
  1.0 x 1.0mm - 1000µm ±30µm
  0.1 x 1.5mm (2) - 100µm ±5µm and 1500µm ±40µm
  0.5 x 1.5mm - 500µm ±20µm and 1500µm ±40µm
- Hydrophilic Coatings: 2.5nm ±0.25nm
- Hydrophobic Coatings: 2.5nm ±0.25nm

Effects of Tilt

Due to the 35° etching angle the PELCO® Si_3N_4 Support Films on the frames can be tilted to 35° for unobstructed viewing, even if the specimen is close to the edge of the membrane. For higher tilting angles, the specimen needs to be in the center of the membrane. To allow for the highest possible tilt angle a window size of 1.5 x 0.5mm has been made available, which allows for tilting angles up to 70° with a viewable area of 40%. Maximum tilt angle with a specimen in the center is 75°.