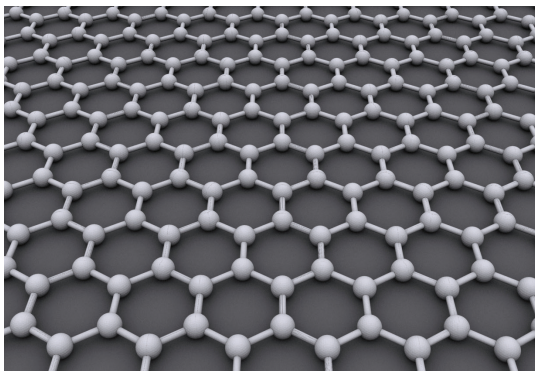
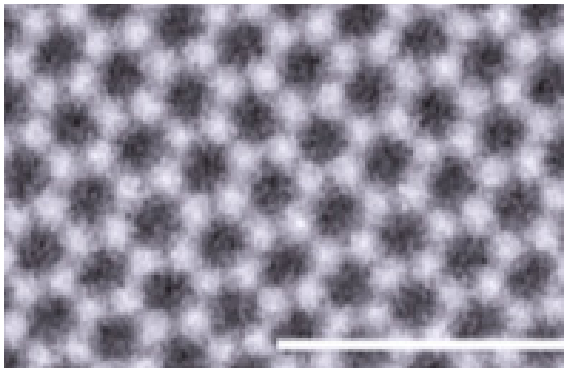
PELCO® GRAPHENE & GRAPHENE OXIDE FILMS

TEM Support Films & Substrates for TEM, SEM, SPM & Research



Crystalline Structure of Graphene Film

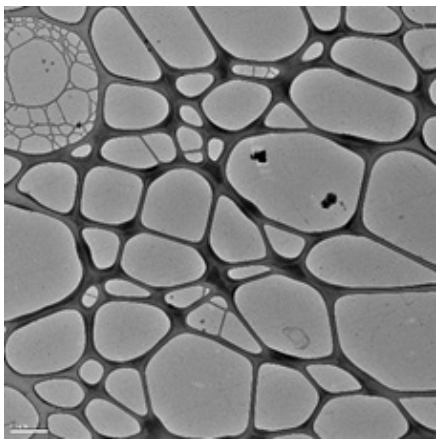


MAADF Image of Single-layer Graphene (bar = 1nm) on Holey Silicon Nitride Product. *Ref: J. Kotakoski, et. al. Nano Letters, 2015*

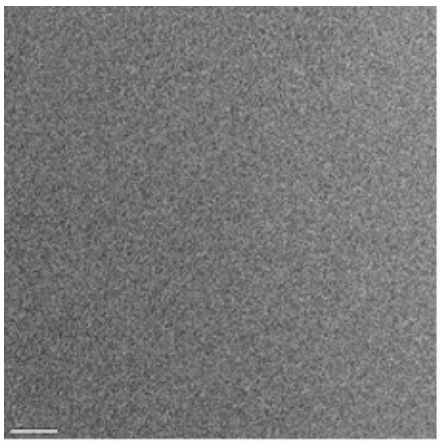
PELCO® Graphene products are available on a variety of substrates including lacey carbon, 2000 mesh Cu grid, holey silicon nitride, and ultra-flat SiO_2. PELCO® Graphene is available in different thicknesses: single layer, 2-layers, 3-5, and 6-8 layers. Graphene sheets with thicker layers are available by special order.

GRAPHENE ON LACEY CARBON

The PELCO® Graphene TEM Support Films are suspended on a lacey carbon film on a 300 mesh grid (Prod. No. 01895). The Graphene Films we offer have either single, 2, 3-5, or 6-8 layer graphene sheets and cover the entire TEM grid. The usable area is around 75% due to some unavoidable folds and wrinkles in the graphene sheets. Graphene, with its unique properties, offers a support film layer that is more conductive and also much thinner than the average carbon support film. Although it is a crystalline support film, its contribution to signal formation is relatively low. This makes the single and 2-layer Graphene Support Film ideal for high resolution imaging, imaging of nanoparticles and imaging of weak contrast materials/interfaces.

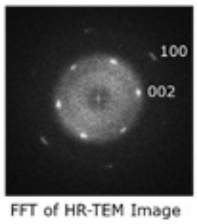


Low-magnification TEM image of single-layer graphene on lacey carbon.
Marker bar = 500nm



High-resolution TEM image of single-layer graphene showing a typical region for imaging.
Marker bar = 5nm

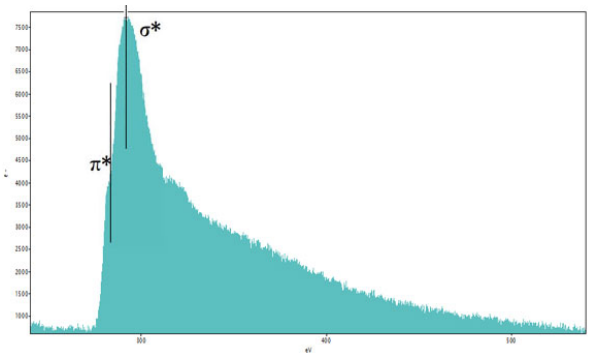
SAED (Marker Bar = 21/nm)



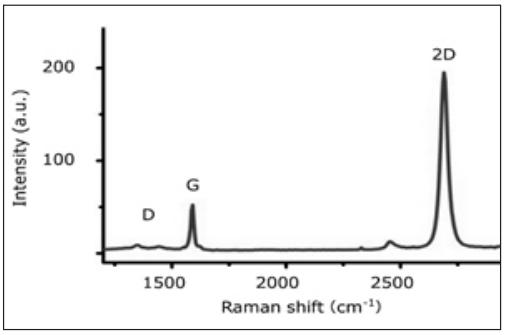
FFT of HR-TEM Image

Graphene product ordering information inside.

PELCO® GRAPHENE PRODUCTS FROM TED PELLA, INC.



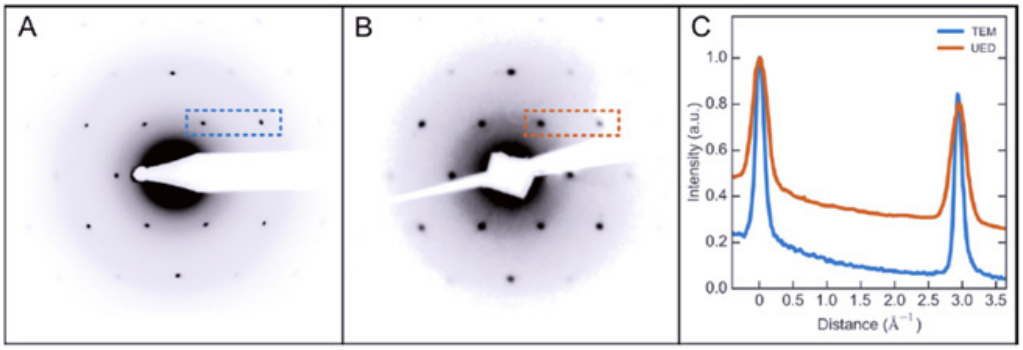
EELS Spectrum of single-layer Graphene



Typical Raman Spectrum of single-layer Graphene

GRAPHENE SPECIFICATIONS

- The sheet resistance for a single layer of Graphene Film is 600Ω/cm².
- The thickness for a single layer of Graphene is approximately 0.35nm, and transparency is in the order of 96.4%.
- The thickness for 2 layers of Graphene is approximately 0.7nm, and transparency is in the order of 92.7%.
- The thickness for 3-5 layers of Graphene is between 1.0 - 1.7nm, and transparency ranges from 90.4 - 85.8%.
- The thickness for the 6-8 layers of Graphene is between 2.1 - 2.8nm, and transparency ranges from 83.2 - 78.5%.



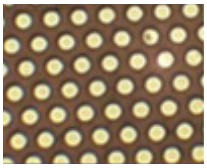
PELCO® Graphene has an in-plane modulus of 0.9TPa, compared to 1.0 TPa for Graphene produced by the Scotch™ Tape method.

Comparison of the diffraction pattern of Graphene on copper mesh coated with a lacey carbon film measured with (a) a transmission electron microscope (TEM) at 80 kV and (b) the ultrafast electron diffraction (UED) setup at 6 kV. The line profiles in (c) correspond to the highlighted regions in the diffraction patterns in (a) and (b). These data have been normalized to the intensity of the first order peak. The widths and locations of neighboring Bragg peaks were used to estimate the transverse coherence length of the UED setup. Ref: Badali, et. al. Struct. Dyn. 3, 034302 (2016)

PELCO® Graphene TEM Support Films are available in packs of 5, 10 or 25 in the PELCO® #160 TEM grid box.

21710-x*	PELCO® Single Layer Graphene TEM Support Films on Lacey Carbon, 300 Mesh Copper Grids	pkg
21720-x*	PELCO® 2- Layer Graphene TEM Support Films on Lacey Carbon, 300 Mesh Copper Grids	pkg
21740-x*	PELCO® 3-5 Layer Graphene TEM Support Films on Lacey Carbon, 300 Mesh Copper Grids	pkg
21770-x*	PELCO® 6-8 Layer Graphene TEM Support Films on Lacey Carbon, 300 Mesh Copper Grids	pkg

*Note that "x" in these part numbers denotes the number of grids in the package and should be substituted as follows: "5" for a pack of 5, "10" for a pack of 10, and "25" for a pack of 25.



GRAPHENE ON ULTRA-FINE 2000 MESH COPPER TEM GRIDS

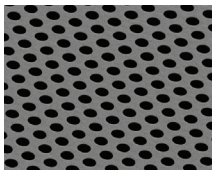
This Graphene is directly supported by #G2000HA ultra-fine 2000 mesh copper TEM grids with 6.5µm circular holes and a pitch of 12.5µm. The open area for this type of grid is 41%. The ultra-fine 2000 mesh TEM grid is supported by a #4510 PELCO® Synaptek™ 1 x 2mm slotted grid to give it the required stiffness. Total thickness of the graphene, 2000 mesh and PELCO® Synaptek™ grid stack is approximately 108µm. The slot in the PELCO® Synaptek™ grid is 1 x 2mm. The graphene sheet covers the entire TEM grid and leaves freestanding graphene covering the 6.5um holes. Total usable area is approximately 75% over the 1 x 2mm

slot area due to unavoidable folds and wrinkles in the graphene sheet. Available with single, 2, 3-5 and 6-8 layer graphene sheets. A research-ready product, suitable for UHR imaging or as an experimental platform. The specifications of the graphene are the same as those on the previous page.

PELCO® Graphene on Ultra-fine 2000 Mesh Cu Grids are supported by 1 x 2mm Synaptek™ Slotted Grids

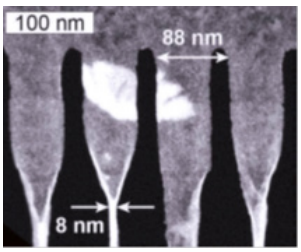
21910-x*	PELCO® Single Layer Graphene on Ultra-fine 2000 Mesh Copper TEM Grids	pkg
21920-x*	PELCO® 2- Layer Graphene on Ultra-fine 2000 Mesh Copper TEM Grids	pkg
21940-x*	PELCO® 3-5 Layer Graphene on Ultra-fine 2000 Mesh Copper TEM Grids	pkg
21970-x*	PELCO® 6-8 Layer Graphene on Ultra-fine 2000 Mesh Copper TEM Grids	pkg

*Note that "x" in these part numbers denotes the number of grids in the package and should be substituted as follows: "5" for a pack of 5, "10" for a pack of 10, and "25" for a pack of 25.



GRAPHENE ON PELCO® HOLEY SILICON NITRIDE

This Graphene product is supported by #21535-10 Holey Silicon Nitride which has 2.5µm holes with a 4.5µm pitch in 200nm Si_3N_4 over a 0.5 x 0.5mm window size. The graphene sheet covers the complete window with the ultraflat Si_3N_4 holey membrane and leaves free standing graphene covering the 2.5µm holes. Total usable area is approx. 75% due to unavoidable folds and wrinkles in the graphene sheet. Available with single, 2, 3-5, and 6-8 layer graphene sheets. A research-ready product, suitable for UHR imaging or as ultra-flat experimental platform. The specifications of the graphene are the same as mentioned on the previous page. Supplied in #160 PELCO® TEM grid box.

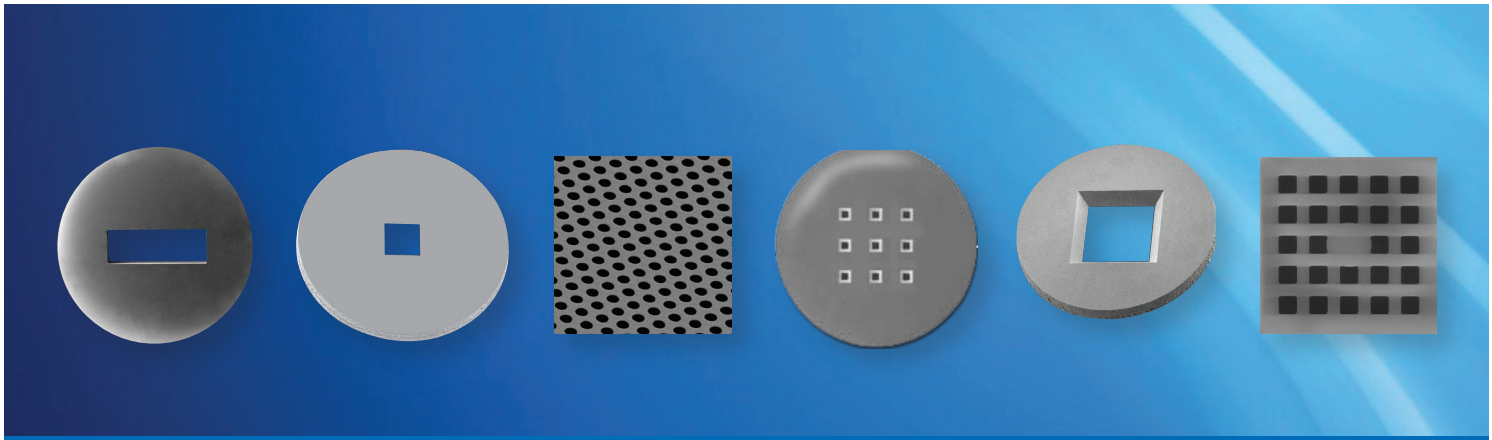


Example of nanopatterning of an atomically thin matter-wave beam splitter from a single-layer Graphene on Holey Silicon Nitride product. *Ref: C. Brand, et. al. Nature Nanotechnology, Vol. 10, Oct. 2015*

PELCO® Graphene on Holey Silicon Nitride is available in packs of 5, 10 or 25 in the PELCO® #160 TEM grid box.

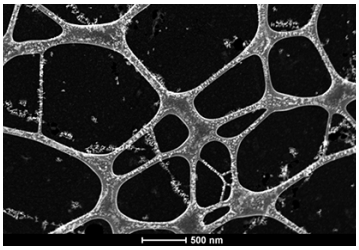
21712-x*	PELCO® Single Layer Graphene on Holey Silicon Nitride, 2.5µm Holes, 0.5 x 0.5mm Window	pkg
21722-x*	PELCO® 2- Layer Graphene on Holey Silicon Nitride, 2.5µm Holes, 0.5 x 0.5mm Window	pkg
21742-x*	PELCO® 3-5 Layer Graphene on Holey Silicon Nitride, 2.5µm Holes, 0.5 x 0.5mm Window	pkg
21772-x*	PELCO® 6-8 Layer Graphene on Holey Silicon Nitride, 2.5µm Holes, 0.5 x 0.5mm Window	pkg

*Note that "x" in these part numbers denotes the number of grids in the package and should be substituted as follows: "5" for a pack of 5, "10" for a pack of 10, and "25" for a pack of 25.



PELCO® GRAPHENE & GRAPHENE OXIDE FILMS

TEM Support Films & Substrates for TEM, SEM, SPM & Research



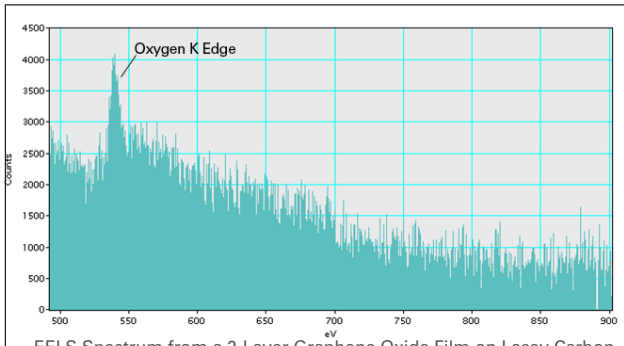
2-layer Graphene Oxide Film on Lacey Carbon

PELCO® GRAPHENE OXIDE TEM SUPPORT FILMS & SUBSTRATES

The PELCO® Graphene Oxide films are based on the single and 2-layer PELCO® Graphene Films. The form in which they are offered is the same as the graphene films with the difference that the graphene films are oxidized using a proprietary oxidization process. This makes the films hydrophilic and more suitable for life science applications and research.

The graphene oxide films cover the entire lacey carbon, holey silicon nitride or the silicon dioxide substrates. For technical details on supports, please look at the technical details of the single and 2-layer graphene films.

The user can expect to find around 70% graphene oxide coverage. Due to the fabrication process used, some 10-100nm diameter pores are to be found randomly scattered about the graphene oxide film. This, however, still provides far better coverage compared to the graphene oxide flakes technique.



EELS Spectrum from a 2-Layer Graphene Oxide Film on Lacey Carbon

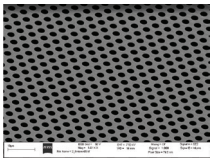
The thickness of the single layer of graphene oxide film is 0.8 - 1.2nm as measured by EELS.

The thickness of the 2-layer graphene oxide film is 1 - 1.5nm as measured by EELS.

PELCO® GRAPHENE OXIDE

The basic structure is the same as the graphene TEM supports; lacey carbon on a 300 mesh Cu grid and on top of the lacey carbon is the graphene oxide. The graphene oxide films are research ready and offer large areas of graphene oxide over the complete TEM grid area. Available in packages of 5,10 or 25 in the #160 PELCO® TEM grid box.

21810-x* PELCO® Single Layer Graphene Oxide TEM Support Films on Lacey Carbon, 300 Mesh Copper Grids ..... pkg
21820-x* PELCO® 2- Layer Graphene Oxide TEM Support Films on Lacey Carbon, 300 Mesh Copper Grids ..... pkg
*Note that "x" in these part numbers denotes the number of grids in the package and should be substituted as follows: "5" for a pack of 5, "10" for a pack of 10, and "25" for a pack of 25.



GRAPHENE OXIDE ON PELCO® HOLEY SILICON NITRIDE

Graphene oxide supported by #21535-10 Holey Silicon Nitride which has 2.5µm holes with a 4.5µm pitch in 200nm Si_3N_4 over a 0.5 x 0.5mm window size. The graphene oxide is deposited over the complete 3mm frame on the flat side. Available in packages of 5,10 and 25 in the #160 PELCO® TEM grid box.

PELCO® Graphene Oxide on Holey Silicon Nitride is available in packs of 5, 10 or 25.

21812-x* PELCO® Single Layer Graphene Oxide on Holey Silicon Nitride, 2.5µm Holes, 0.5 x 0.5mm Window ..... pkg
21822-x* PELCO® 2- Layer Graphene Oxide on Holey Silicon Nitride, 2.5µm Holes, 0.5 x 0.5mm Window ..... pkg
*Note that "x" in these part numbers denotes the number of grids in the package and should be substituted as follows: "5" for a pack of 5, "10" for a pack of 10, and "25" for a pack of 25.

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