Optical Cryostat - Ultra Low Vibrations

The **CS210*F-GMX-20** pairs our largest cryocooler, the DE-210, with our X-20 Ultra Low Vibration interface to offer unprecedented cooling power at nanometer vibration levels. The **CS210*F-GMX-20** uses a Helium Exchange Gas to decouple the sample space from the cold tip of the DE210 Cryocooler. This prevents almost all vibration from being transmitted to the sample. Because the exchange gas is inherently less efficient than cooling by conduction, t the base temperature of the sample may be ~1K higher than the cryocooler. Additionally the GMX-20 interface requires the cold tip down orientation to facilitate convective cooling of the exchange gas.

Applications

- Mössbauer
- Low Vibration Optical Experiments
- Quantum Dots
- Photoluminescence (PL)
- Micro-Raman (Micro-PL)
- Micro-Spectroscopy
- Magneto Optical Kerr Effect (MOKE)
- Nanoscience
- Ellipsometry

Features

- **Ultra Low Vibrations (3-5 nm)**
- Pop-Off optical block for easy in-situ sample change
- Beryllium and Kapton windows available for Mössbauer experiments
- Large clear view optical windows (1.25 in)
- Large sample viewing angle for optical collection (F/1.8)
- Cold Tip Down Orientation
- Fully customizable

Typical Configuration

- Cold head (DE-210AF)
- Compressor (ARS-10HW)
- 2 Helium Hoses
- GMX-20 Ultra Low Vibration Interface
- Stainless steel vacuum shroud for optical and electrical experiments with pop-off optical block
- Nickel Plated OFHC copper radiation shield
- 2 High purity quartz windows
- Instrumentation for temperature measurement and control:
  - 10 pin hermetic feed through
  - 50 ohm thermofoil heater
  - Silicon diode sensor curve matched to (±0.5K) for control
  - Calibrated silicon diode sensor (±12 mk) with 4 in. free length for accurate sample measurement.
- Wiring for electrical experiments:
  - 10 pin hermetic feed through
  - 4 copper wires
- Sample holder for optical and electrical experiments
- Temperature Controller

Options and Upgrades

- 4K Coldhead (0.8W @ 4.2K)
- 450K High Temperature Interface
- 800K High Temperature Interface
- Custom temperature sensor configuration (please contact our sales staff
- Custom wiring configurations (please contact our sales staff)
- Window material upgrades (custom materials available)
- Sample holder upgrades (custom sample holders available)

The above picture shows a cryocooler with a vacuum shroud, radiation shield, and sample holder installed.

The above picture shows the DE210 Cryocooler installed on the GMX-20 interface with the vacuum shroud and radiation shield removed.

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Cooling Technology-

DE-204	Closed Cycle Cryocooler
Refrigeration Type	Pneumatically Driven GM Cycle
Liquid Cryogen Usage	None, Cryogen Free

Temperature*- GMX-20 adds ~1K to base temperature

DE-210AF	< 9K - 350K
DE-210SF	< 3K - 350K
With 800K Interface	(Base Temp + 2K) - 700K
With 450K Interface	(Base Temp + 2K) - 450K
Stability	0.1K
*Based on bare cold head with a closed radiation shield, and no additional sources of experimental or parasitic heat load	

Sample Space -

Diameter	61 mm (2.4 in.)
Height	39 mm (1.53 in.)
Sample Holder Attachment	1/4 - 28 screw
Sample Holder	www.arscryo.com/Products/SampleHolders.html

Optical Access-

Window Ports	4 - 90° Apart
Diameter	41 mm (1.63 in)
Clear View	32 mm (1.25 in)
#/F	1.8
Window Material	www.arscryo.com/Products/WindowMaterials.html

Temperature Instrumentation and Control - (Standard) -

Heater	50 ohm Thermofoil Heater anchored to the coldtip
Control Sensor	Curve Matched Silicon Diode installed on the coldtip
Sample Sensor	Calibrated Silicon Diode with free length wires
Contact ARS for other options	

Instrumentation Access-

Instrumentation Skirt	Bolt-On, Stainless Steel
Pump out Port	1 - NW 25
Instrumentation Ports	2
Instrumentation Wiring	Contact sales staff for options

Vacuum Shroud -

Material	Aluminum
Length	388 mm (15.29 in)
Diameter	86 mm (3.38 in) at the sample space
Width	86 mm (3.38 in) at the sample space

Radiation Shield -

Material	Nickel Plated OFHC Copper
Attachment	Threaded
Optical Access	0, 2, or 4 (customer specified)

Cryostat Footprint -

Overall Length	787 mm (31 in)
Motor Housing Diameter	156 mm (6.14 in)

Cryocooler Model		**DE-210AF**		**DE-210SF**	
	Frequency	60 Hz	50 Hz	60 Hz	50 Hz
Base Temperature		<9K	<9K	<9K	<9K
Cooling Capacity*	4.2K	-	-	0.8W	0.8W
	10K	4W	4W	9W	9W
	20K	17W	17W	16W	16W
	77K	25W	25W	25W	25W
Radiation Shield Cooling Capacity		60W	60W	60W	60W
Cooldown Time	20K	35 min	35 min	40 min	40 min
	Base Temperature	70 min	70 min	80 min	80 min
Compressor Model		ARS-10HW		ARS-10HW	
Typical Maintenance Cycle		12,000 hours		12,000 hours	

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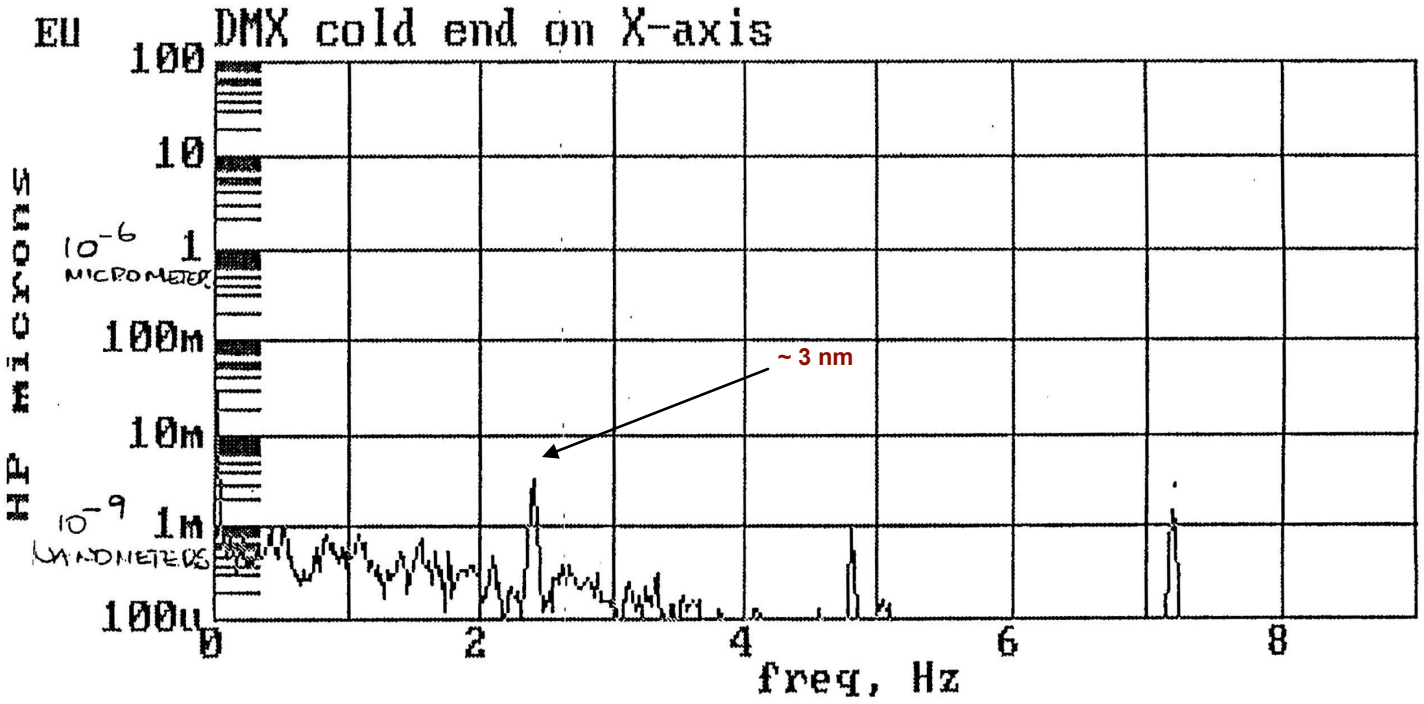
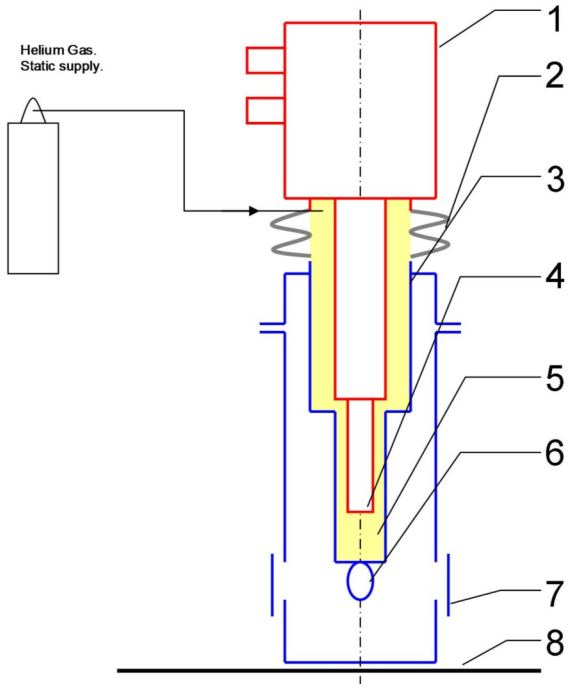
DE202*F-DMX-20 Vibration Spectra



Understanding the DMX-20 Interface

The **X-20** Interface uses a Helium Exchange Gas to decouple the sample space from the cold tip of the cryocooler. This prevents almost all vibration from being transferred to the sample space. Scientists have demonstrated vibration levels as low as 3-5 nm with the **DE202*F-DMX-20** (as shown above)

1. The Cryocooler is supported from a Floor Stand
2. The soft rubber bellows minimize vibrations transmitted to the sample while keeping in the Helium Exchange Gas
3. The X-20 interface has no contact with the cryocooler except through the rubber bellows.
4. The cold tip has 10-30 micron vibrations (depending on CCR model) but no direct contact with the sample space.
5. Convective pockets of Helium Exchange Gas cools the sample space.
6. The sample is only in contact with the X-20 Interface
7. Windows for Optical Experiments
8. The X-20 Interface is mounted directly on a (user provided) Vibration Isolation Table.



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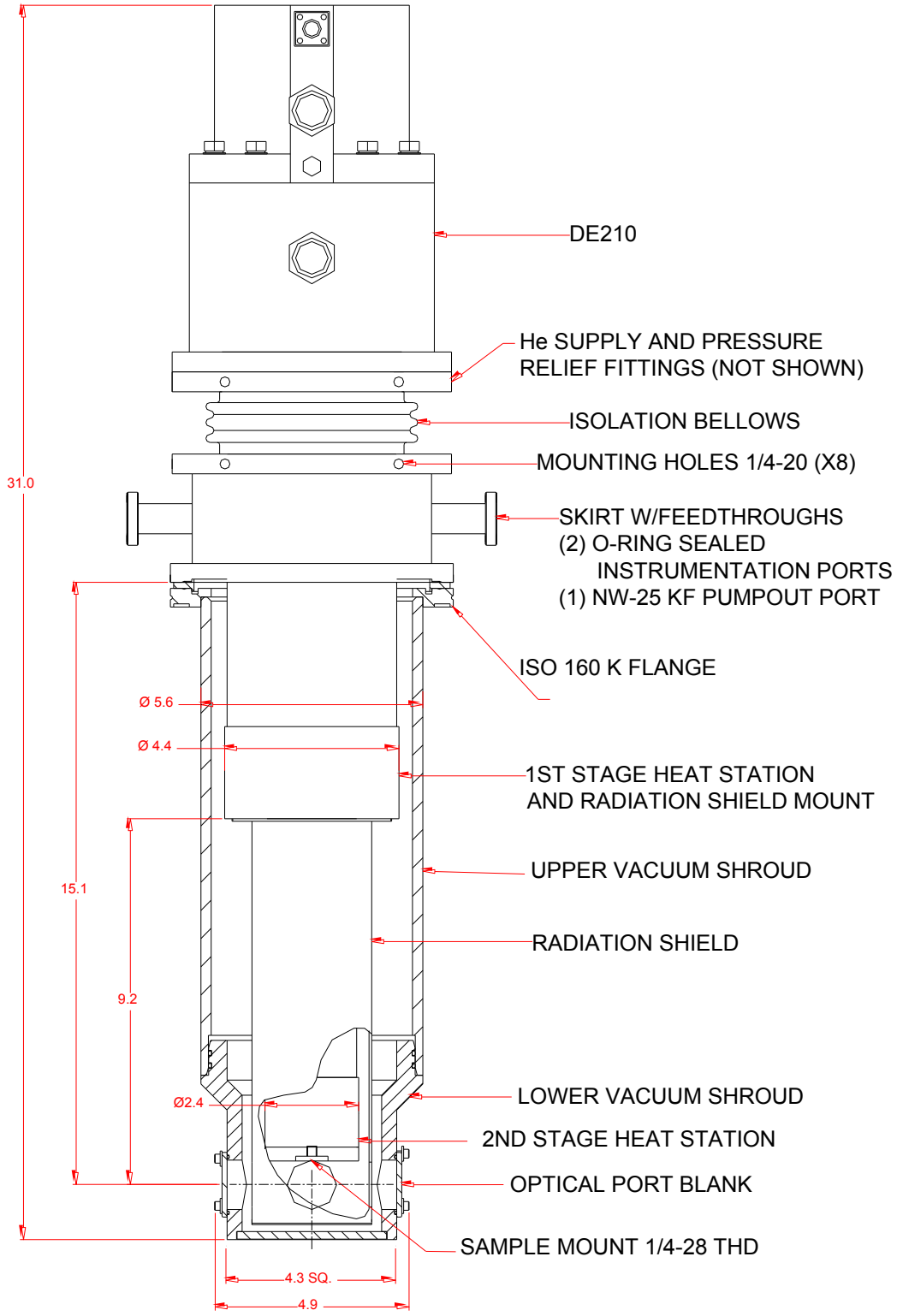
DE210*F-GMX-20 Outline Drawing



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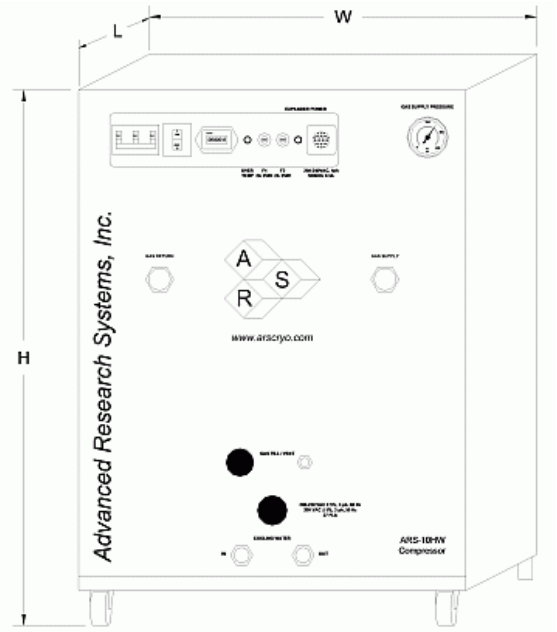
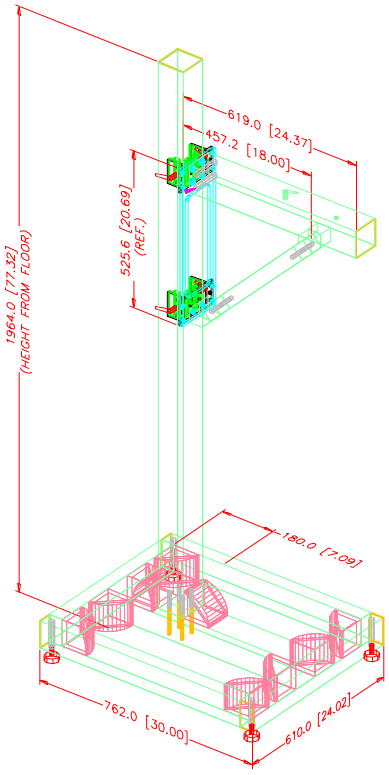
Direct Mounting

The DMX-20 can be direct mounted on the Cryocooler. The vibrations at the sample will go up to 140 nm. It can be useful if the sample has to be translated in XYZ.

ARS-10HW Compressor



Floor Stand



Compressor Model		ARS-10HW	
	Frequency	60 Hz, 3 Phase	50 Hz, 3 Phase
Standard Voltage	Min	208 V	190 V
	Max	230 V	210 V
High Voltage	Min	380 V	440 V
	Max	415 V	480 V
Power Usage	Three Phase	7.7 kW	7.7 kW
Refrigerant Gas		99.999% Helium Gas, Pre-Charged	
Ambient Temperature		5 - 40 C (40—104 F)	
Cooling Water	Consumption	5.7 L / min (1.5 Gal. / min)	
	Temperature	< 20 C (68 F)	
	Connection	1/2 in. Swagelok Fitting	
Dimensions:	L	483 mm (19 in)	
	W	533 mm (21 in)	
	H	617 mm (24.3 in)	
Weight		105 kg (230 lbs)	
Typical Maintenance Cycle		12,000 hours	

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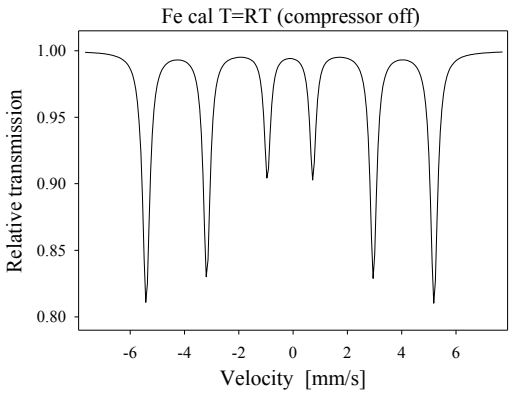
Mossbauer Spectra with DMX-20

Cryocooler Off



Calculated parameters:

WID=0.269 mm/s
W13=1.17

W23=1.08

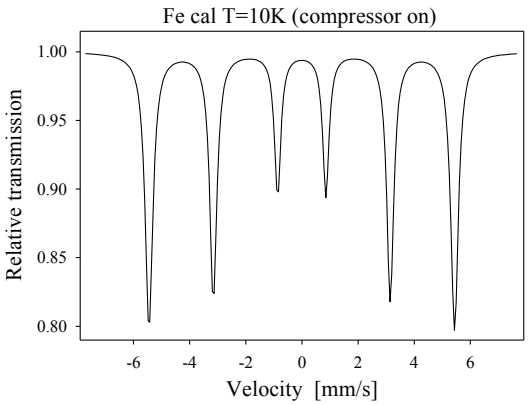
ISO=0.000 mm/s

BHF=32.94T

Calibration spectrum:

Measurement with metallic iron foil (thickness 25 mm)

Cryocooler On



Calculated parameters:

WID=0.270 mm/s
W13=1.21

W23=1.11

ISO=+0.115 mm/s

BHF=33.81T

Calibration spectrum:

Measurement with metallic iron foil (thickness 25 mm)

When the system is properly mounted to the wall and the table and properly adjusted then the effect of vibrations induced by the working compressor is very small (almost negligible).

The broadening (rather no broadening!) is fully reproducible and is well below 2%. Such broadening has practically no effect and in almost all cases can be ignored. However, compare the lin ewidths calculated in the same way!

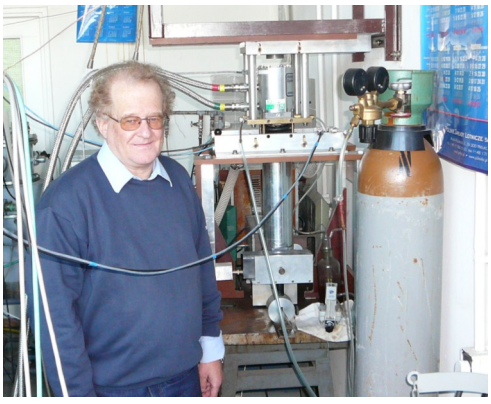
The Displex system is virtually vibration free!

Prof. Dr. habil. Michal Kopcewicz

Institute of Electronic Materials Technology

WARSAW, Poland

Mossbauer Cryostat, DMX-20



Prof. Dr. habil. Michal Kopcewicz

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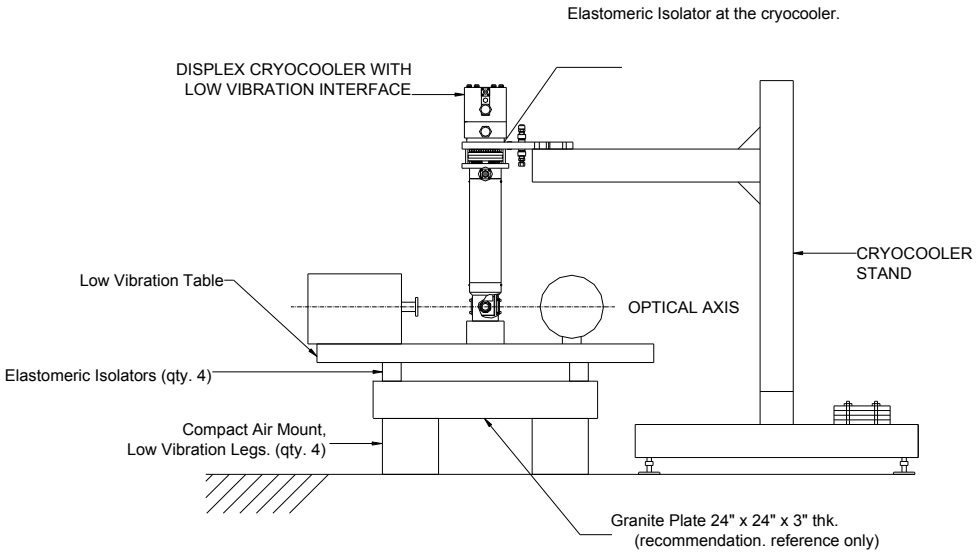
Possible Mossbauer Configuration



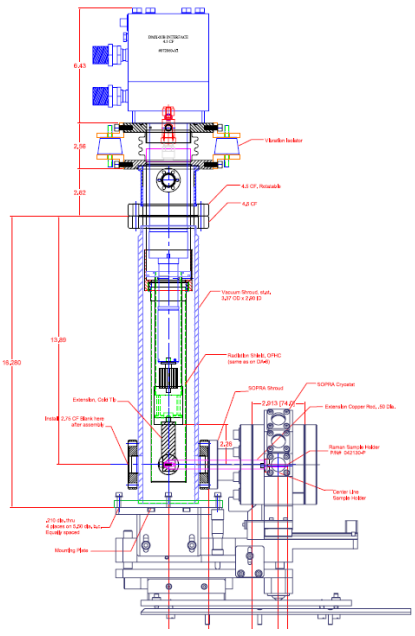
For maximum isolation proper mounting of the system is important. ARS offers a special ULV stand to isolate the ultra low vibration cryostat from the vibrating components of the cooler and the floor vibrations.

The cryocooler stand can be adjusted for the proper height, this holds the cooler.

The cryostat is mounted on the low vibration table. which consists of a high mass granite block (User supplied), resting on 4 air legs (optional ARS offering). Additional elastomeric isolators additional filter the unwanted frequencies from the floor to the cryostat.

System can be tested by shutting off the cryocooler only and watching the vibration effect on the experiment.

Ellipsometry



Low Vibration system for SOPRA Ellipsometer

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SEM Setup

The picture shows the Displex and its interface. All items showing stainless steel in the photo are modifications to our JSM-5910 SEM. Please also note the published papers on my website, which demonstrate CL results that were acquired with this cooling system.

The sample temperature, is between 40 K and 50 K.

Courtesy; Prof. Dan Rich, Ben Gurion University, Beer Sheva, Israel.

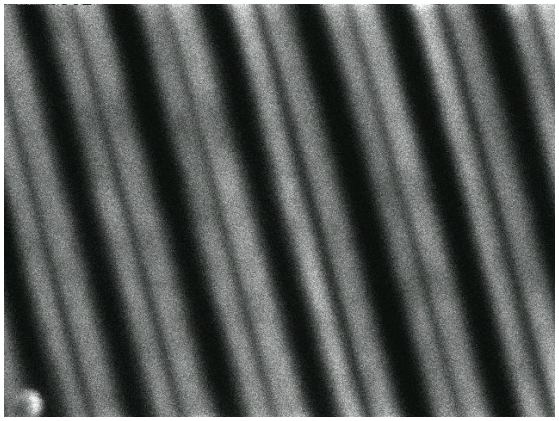
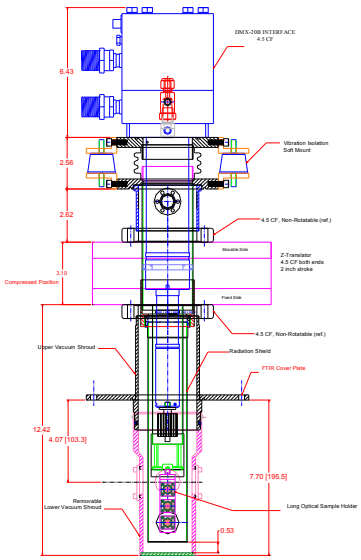


Image of a InGaN/GaN quantum well grown on a patterned GaN substrate. The patterning consists of stripes with a periodicity of 10 microns.

Monochromatic CL image (Mag. 2000) taken with a 390 nm detection wavelength.

The degradation of image quality from room temperature and 50K suggests that the vibration is less than 10nm.

FTIR Setup



Low Vibration system for FTIR spectrometer. Sample holder with 3 samples can be translated in Z direction.

Low Vibration system for BOMEM, DA8 FTIR spectrometer.

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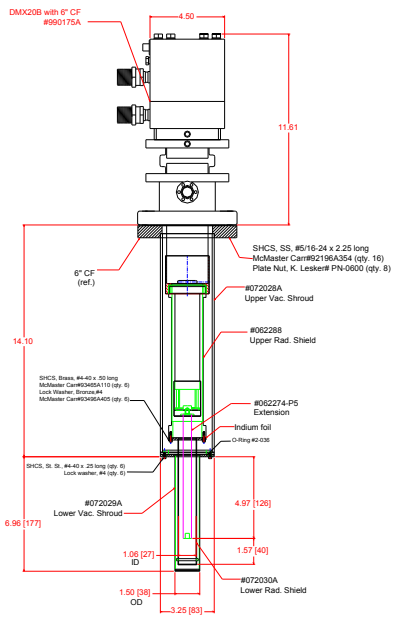
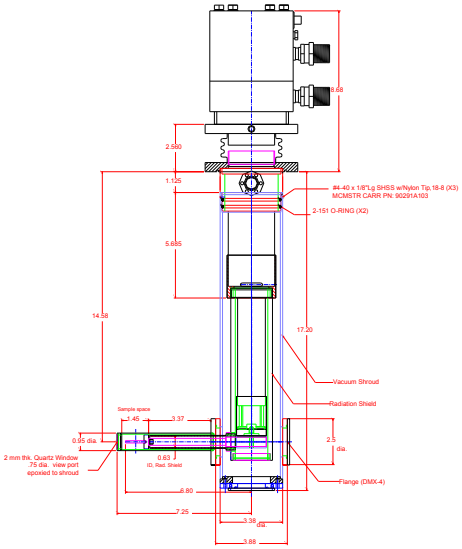
Magneto Electrical Experiments



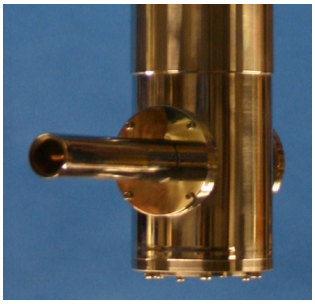
The vacuum shroud becomes narrow to permit sample insertion into a small magnet pole space.

The vacuum shroud becomes narrow to permit sample insertion into a small magnet pole space.

Magneto Optical Experiments (MOKE)



Low Vibration Side looking window can be placed in a MOKE, (Magneto Optical Kerr Effect). Sample can be located in any plane. The pole spacing can be as low as 1 inch.



Small diameter vacuum housing can be inserted into a narrow gap (high field). The optical window allows collection of light from the sample. The window can be very close to the sample for short focal length objective.