ASC OP – Task Force 6: IR Materials and SPIE IR Materials Working Group

Monday, February 3rd, 2014, 16:00 – 18:30 PST

Intercontinental Hotel
888 Howard St.
San Francisco, CA 94103
Laurel Hill Room

Welcome, Introductions, and Appointment of Note Taker

- ASC OP/TF6 (OEOSC)
  - Write the materials standards standards
  - Coordinate with other TF developing supporting standards
- IRMSWG (SPIE)
  - Meetings will consist of status reports, technical evaluations, recommendation
  - Advise TF6 regarding instrumentation and measurement methods
  - Work the details of the measurements
    - Test plans
    - Instrument development /upgrades
    - Sampling protocols
    - Sample specs and procurement
  - Identify funding sources

Draft Agenda

1. Welcome, Introductions, and appointment of note taker – A. Phenis
2. Adoption of Agenda – A. Phenis
3. Approval of previous meeting minutes – A. Phenis
4. Reports
    1. Refractometer status update (NIST) – L. Hanssen
    2. State and Commerce guidance on ITAR (LMCO) – A. Phenis for G. Wiese
    3. Pilot Refractive Index Measurements (LMCO) – A. Phenis for G. Wiese
    4. Sampling protocols update (Leidos) – A. Phenis
    5. Materials Metrology Instrumentation (Schott) – N. Carlie
    6. Standardized reference wavelengths (OEOSC) – D. Aikens
    7. Other reports and updates – Project Leaders
5. Group Discussion Topics – A. Phenis
6. Time and Place for next meeting - suggestions
    1. Teleconference
    2. SPIE DSS, Baltimore, MD Monday May 5, 2014
    3. SPIE Annual Meeting, San Diego, CA Monday August 18, 2014
    4. Photonics West 2015, San Francisco, Sunday February 9, 2015
7. Adjourn – A. Phenis

Refractometer status update

L. Hanssen – NIST

State and Commerce guidance on ITAR

A. Phenis (Leidos) for G Wiese

Pilot Refractive Index Measurements (LMCO)

A. Phenis (Leidos) for G Wiese

Purpose and Approach

Background

Number of samples is a major cost driver for large measurements program. To minimize cost, minimize the required number of samples.

Purpose

Determine dependence of selected properties (index and transmission) on location within a batch of material. Helps to define sampling protocol for larger program.

Approach

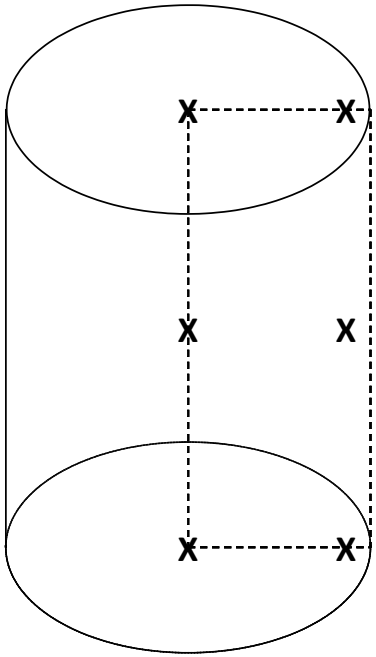
- **Limited number of samples.**
- **Coarsely sample the volume of a single batch of material.**
- **Sample material and fab funded by material suppliers.**
- **Refractive index and transmittance measurements of prism samples by NIST.**
- **Refractive index measurements of disk samples by PNNL.**
- **Compare results of refractive index measurements.**

Participating Material Suppliers

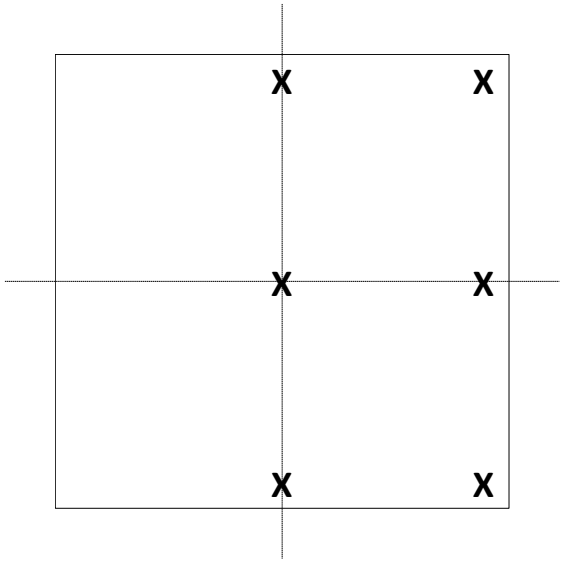
Supplier	Material(s)	Fab	
		In	Out
Armorline	Spinel		X
Dow	ZnS (MS)		X
Fairfield Crystal	CaF_2, BaF_2	X	
Freiberger Compound Materials	GaAs	NA	NA
Hellma Materials	CaF_2, BaF_2		X
II-VI	ZnSe	X	
ISP Optics	BaF_2	X	
Lattice Materials	Silicon		X
Lightpath Tech	BD2		X
Novotech	Silicon		X
Photonic Sense	Germanium		X
Schott	IRG26		X
Umicore	GASIR1	X	

Suggested Sample Locations

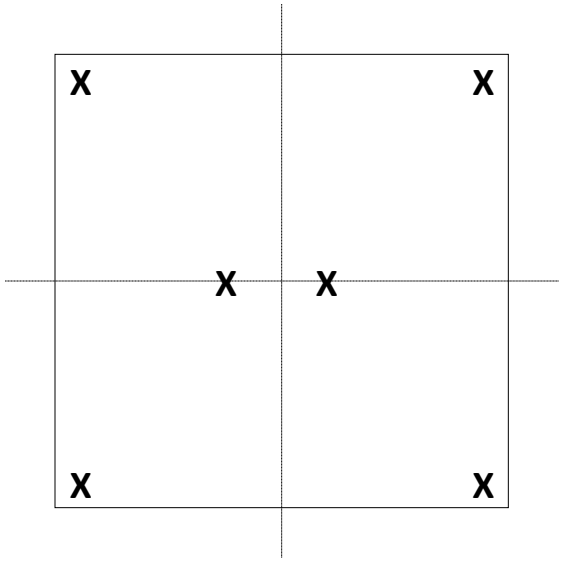
(Not to scale)



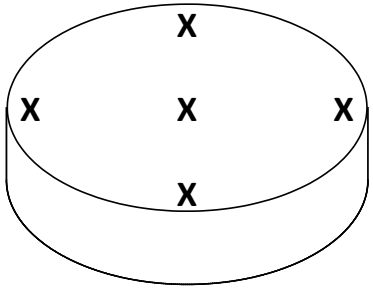
Cylindrical Ingot



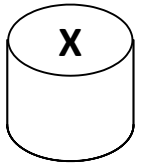
CVD Plate



Spinel Plate



Circular Plate



Small Puck

Prism Sample
(Prism Refractometer/Transmittance)

SURFACE	SURFACE QUALITY	POWER TOL OVER CA IN FRINGES	IRREGULARITY TOL OVER CA IN FRINGES	MIN CLEAR APERTURE	COATING	TEST WAVELENGTH
A	60-40	NOTE 7.A	NOTE 7.A	SEE DRAWING	NONE	633 NM
B	60-40	NOTE 7.A	NOTE 7.A	SEE DRAWING	NONE	
C	60-40	NOTE 7.B	NOTE 7.B	NOTE 8	NONE	
D	60-40	NOTE 7.B	NOTE 7.B	NOTE 8	NONE	

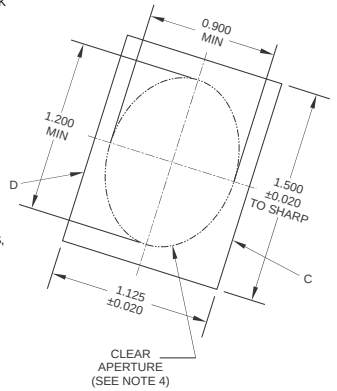
REVISIONS		
REV	DESCRIPTION	DATE
A	Add polish of surfaces C and D	12/4/2013

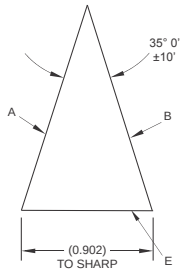
NOTES:

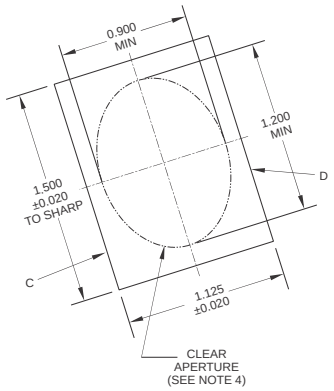
1. DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED.
2. MATERIAL: MULTISPECTRAL ZINC SULFIDE.

   BLANKS TO BE PROVIDED BY MATERIAL MANUFACTURER. EACH BLANK SHALL BE MARKED, USING AN INDELIBLE MARKER, WITH A MANUFACTURER'S SERIAL NUMBER INDICATING
   A. MANUFACTURER NAME
   B. MATERIAL TYPE
   C. MATERIAL BATCH NUMBER FROM WHICH BLANK WAS TAKEN
   D. LOCATION OF THE BLANK WITHIN THE BATCH
3. THE MANUFACTURER'S SERIAL NUMBER FOR THE BLANK SHALL ACCOMPANY THE PRISM SAMPLE THROUGHOUT THE FABRICATION PROCESS.
4. CLEAR APERTURES OF SURFACES "A" AND "B" CENTERED ON SURFACES.
5. SURFACES "A", "B", "C", AND "D" POLISHED; ALL OTHERS GROUND. UNLESS OTHERWISE SPECIFIED, SURFACE QUALITY, EDGE CHAMFERS, AND EDGE CHIPS IN ACCORDANCE WITH MIL-PRF-13830. SCRATCH WIDTH DENOTES WIDTH OF SCRATCH IN MICRONS.
6. CHAMFER ALL EDGES 0.040-0.060 FACE WIDTH. FACE OF CHAMFER APPROXIMATELY EQUALLY INCLINED TO THE ADJACENT FACES.
7. SURFACE POWER AND IRREGULARITY:

   A. RMS SURFACE DEVIATION OF SURFACES "A" AND "B" FROM IDEAL PLANE, AFTER REMOVAL OF PISTON AND TILT ERROR, SHALL BE LESS THAN 16 NM (λ/40 RMS AT INDICATED TEST WAVELENGTH.) SURFACE POWER SHALL NOT BE REMOVED IN COMPUTING THE RMS SURFACE DEVIATION.
   B. PEAK TO VALLEY DEVIATION OF SURFACES "C" AND "D" FROM IDEAL PLANE, AFTER REMOVAL OF PISTON AND TILT ERROR, SHALL BE LESS THAN 6330 NM (10 λ AT INDICATED TEST WAVELENGTH).
8. THE CLEAR APERTURE OF SURFACES "C" AND "D" SHALL EXTEND TO WITHIN 0.020 OF THE EDGE CHAMFERS.
9. PYRAMIDAL ERROR BETWEEN SURFACES "A" AND "B", REFERENCED TO SURFACE "C", SHALL BE LESS THAN 5 ARC MINUTES.
10. SURFACE "E" SHALL BE MARKED WITH BLANK MANUFACTURER'S SERIAL NUMBER USING AN INDELIBLE MARKER.







IR MATERIALS STANDARDS WORKING GROUP
SAMPLE PRISM - ZINC SUFLIDE (MS)
647876751-8

Disk Sample
(Prism Coupler Measurements)

SURFACE	SURFACE QUALITY	POWER TOL OVER CA IN FRINGES	IRREGULARITY TOL OVER CA IN FRINGES	MIN CLEAR APERTURE	COATING	TEST WAVELENGTH
A	120-80	SEE NOTE 6	SEE NOTE 6	0.75	NONE	633 NM

REVISIONS		
REV	DESCRIPTION	DATE

NOTES:

1. DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED.

2. MATERIAL: MULTISPECTRAL ZINC SULFIDE.

   BLANKS TO BE PROVIDED BY MATERIAL MANUFACTURER. EACH BLANK SHALL BE MARKED, USING AN INDELIBLE MARKER, WITH A MANUFACTURER'S SERIAL NUMBER INDICATING
   A. MANUFACTURER NAME
   B. MATERIAL TYPE
   C. MATERIAL BATCH NUMBER FROM WHICH BLANK WAS TAKEN
   D. LOCATION OF THE BLANK WITHIN THE BATCH

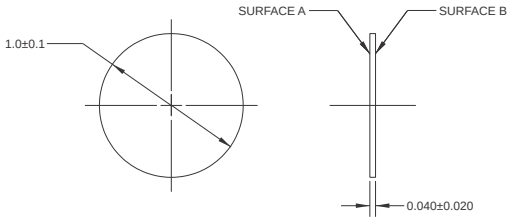
3. THE MANUFACTURER'S SERIAL NUMBER FOR THE BLANK SHALL ACCOMPANY THE DISK SAMPLE THROUGHOUT THE FABRICATION PROCESS.

4. SURFACE "A" POLISHED; ALL OTHERS GROUND. UNLESS OTHERWISE SPECIFIED, SURFACE QUALITY, EDGE CHAMFERS, AND EDGE CHIPS IN ACCORDANCE WITH MIL-PRF-13830. SCRATCH WIDTH DENOTES WIDTH OF SCRATCH IN MICRONS.

5. CHAMFER ALL EDGES 0.005 MINIMUM FACE WIDTH.

6. PV SURFACE DEVIATION OF SURFACE "A" FROM IDEAL PLANE, AFTER REMOVAL OF PISTON AND TILT ERROR, SHALL BE LESS THAN 6 MICRONS (9.5λ AT INDICATED TEST WAVELENGTH).

7. SURFACE "B" SHALL BE MARKED WITH BLANK MANUFACTURER'S SERIAL NUMBER USING AN INDELIBLE MARKER.



IR MATERIALS STANDARDS WORKING GROUP

SAMPLE DISK -
ZINC SULFIDE (MS)

76657675-8

Key Sample Fab Requirements

Prism Sample	
Notes 2, 3, 9	Supplier's serial number indicates supplier, batch information, sample location within batch. Serial number remains with sample during and after fab.
Note 5	All surfaces polished except base of prism.
Note 7	Surfaces A, B: *16 nm (λ/40) RMS, power not removed Surface C, D: 6330 nm (10λ) PV

Disk Sample	
Notes 2, 3, 7	Supplier's serial number indicates supplier, batch information, sample location within batch. Serial number remains with sample during and after fab.
Note 6	Surface A: 6000 nm (9.5λ) PV, power not removed.

* λ/40 requirement can be relaxed for low-index materials, if necessary

Fabrication Bidders

Company	Comments
Inrad	
Optimax	
Reynard Corp.	
Precision Optical	Germanium only

Sampling protocols update

A. Phenis – Leidos

Status

- Pending further data
  - Gary's Pilot Study will hopefully yield useful data to implement a sampling protocol

Purpose

- This standard specifies the sampling procedure to be used for the characterization of optical materials operating in the infrared portion of the electromagnetic spectrum as specified in OP1.007 (to be shown in a later presentation). It will cover:
  - Sampling frequency (temporal)
  - Sample shape and dimensions
  - Sample location(s) within batch
  - Sample orientation
  - Tracking information
    - Material
    - Supplier
    - Batch number/date
    - Sample location/coordinates

Goal

- One Sampling Protocol that covers all materials
- Not require increased characterization burden on the material manufacturers

Reality

- Materials are made via different techniques, shapes, sizes, etc…
- Sampling Protocol will require specific details for specific materials and manufacturing techniques

Standard properties routinely characterized by material manufacturers

Characterized Property

- Homogeneity
- Birefringence
- Transmission
- Visual Inspection
- Material Composition
- Index
- dn/dT
- CTE
- Resistivity
- Strain and/or Grain Boundaries

- Not all of these are pertinent to all materials
- Not all are performed all of the time

Summary

- The Sampling Protocol is pending more info from the Pilot Study

Materials Metrology Instrumentation

N. Carlie – Schott

Standardized reference wavelengths

D. Aikens - OEOSC

Other reports and updates

Project Leaders

Group Discussion Topics

Time and Place for next meeting - suggestions

- Teleconference
  - Date: TBD
- SPIE DSS, Baltimore, MD
  - Monday May 5, 2014
- SPIE Annual Meeting, San Diego, CA
  - Monday August 18, 2014
- Photonics West 2015, San Francisco
  - Sunday February 9, 2015

Adjourn

Thank you for coming to this meeting and we look forward to seeing you in future meetings.