News on Cathodes from INFN

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Outline

• LASA prep. system status and film reproducibility
  • Work done during this year (cathodes production, maintenance, etc.)
  • Multi-wavelengths diagnostic (film properties & parameters reproducibility)

• Analysis of occurred problems
  • Carrier movements and manipulator realignment

• Status of the INFN-like cathode systems
  • FNAL/LBNL/DESY

• A new box pumping system
  • Results on the cathode robustness

• The “new” cathode DataBase
  • A web access for all connected laboratories (statistics, etc.)

• Conclusion and proposal
Production at LASA

Since the last PITZ Collaboration Meeting (Dec. 2010)

• Cathodes production:
  • Short2 for PITZ:
    4 standard Cs₂Te cathodes, shipped on January 2011
    (107.3 - 11.3 - 82.3 - 102.1)
  • Long1 for FLASH:
    4 standard Cs₂Te cathodes, shipped on July 2011
    (90.3 - 94.3 – 104.4- 127.3)
  • LBNL1 for LBNL (APEX):
    3 standard Cs₂Te cathodes + 1 Mo cathode (FNAL plug geometry),
    under shipment by air-plane...
    (409.1 – 417.1 – 407.1 – 410.1)

• Maintenance of the preparation system (Jan-Feb ‘11):
  • Installation of the new masking system
  • Sources replacement (Cs and K), microbalance quartz

• Actual status:
  • No box connected to the preparation system
Masking replacement

107.3 (old masking)

No more scratches on the cathode/plug front surface

90.3 (new masking)
Multiwavelengths diagnostic

The “new diagnostic” allows to measure:

• QE & R @ $\lambda$s during the deposition
to estimate:
• $E_g + E_a$ threshold formation during the deposition
to control:
• Te deposition on the Mo plug
• Completion of the Cs$_2$Te (no Cs excess)
Since 2009 we applied the multi-wavelengths diagnostic during the film deposition (29 cathodes) obtaining:

- **Good reproducibility of the film characteristics**
- **Less sources consumptions**
Spectral response reproducibility

- The new diagnostic allows better control of the cathode growing.
- The reproducibility of produced cathode spectral responses is largely improved.
- The Cs excess is under control. No more low energy shoulder.
Occurred problems: carrier movement

**PITZ:** The carrier Long1 was not moving

- At LASA the carrier was disassembled founding screw of the bayonet (female part) bended.

**FLASH:** realignment of the Huntington manipulator was done
### INFN-like Cathode systems

“Compatibility between all systems”

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<th>Preparation Systems</th>
<th>Transfer System</th>
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- **Possibility to exchange cathodes between all facilities**
- 2 Short boxes
- 4 Long boxes (1 with the new carrier)
- 2 Long boxes (FNAL, new carrier)
- 1 Long box with NEG (LBNL, new carrier)

- **Two different plug shapes:**
  - Standard (16 mm)
  - FNAL (10 mm)
Cathode systems

Preparation Chamber @ FNAL

Standard plug

RF Gun and FLASH linac

Transfer Chamber

FNAL plug

FNAL Transfer system

LASA preparation system

Box long3 in the transport frame
The FNAL Cathode systems

- The FNAL system has been commissioned last spring.
- We have produced Cs$_2$Te cathodes with QE better than 10%.
- The transport box was moved to NML and connected to the gun.
- The manipulation of the cathodes from the transport box to the dummy gun was completed successfully.
LBNL transport box

- Usually cathodes are transported under UHV condition from INFN Milano to the Transfer Systems.
- A battery powered ion getter pump (60 l s\(^{-1}\)) keeps the necessary UHV conditions during transport.

**Limit of the present Transport System**

- Any *power failure* could damage the transported cathodes (ion pump)
- The system is *heavy* (ion pump and power supply)
- The system *cannot be transport by airplane* (HV ion pump)

**The “new” transport box**

- *Varian Ion Getter Pump* 20 l s\(^{-1}\) (mounted on top)
- *Triax Cold Cathode Gauge* (lower range 10\(^{-11}\) mbar)
- *SAES NEG Pump D100* (mounted bottom)

*Light and no need for continous power supply*
Tests done

**Standard Bake-out without NEG**

- Bake out:
  - Temperature of the system raised to 200 °C (cyan line)
  - Temperature of the Ion Pump raised to 250 °C (green line)
  - Pumping during bake out with a TMP (blue line)
  - Overall bake out about 7 days
- During cooldown, when at 200 °C, Ion Getter Pump was switched On
- Final pressure high $10^{-10}$ mbar

**Fast Bake-out with NEG**

- Bake out:
  - Temperature of the chamber raised to 200 °C
  - Temperature of the Ion Pump raised to 250 °C
  - Pumping during bake out with a TMP
  - **First NEG activation** at 200 °C to help in the bakeout process
  - **Second NEG activation** at 120 °C
  - Overall bakeout about 2 days
- Final pressure in the low $10^{-11}$ mbar range
The efficiency of the new pumping system, has been tested:

• switching off the ion pump (for about 3 months)
• measuring the QE vs. $\lambda$

 QE at 254 nm:
• Stable within few percents

 QE at 436 nm:
• Reduced by an order of magnitude
• High stability of the spectral responses
The “new” cathode DB

The TTF Photocathode Database is under upgrading

The status of all new facilities (prep./transf. systems/guns) will be available
The "new" cathode DB

Each labs will have the possibility to insert data relative to rods, plugs, cathodes and their usage in the guns

- Statistics on:
  - QE, Operational lifetime
  - Dark current value, etc.

The web interface for the data loading
Conclusions

• The **new masking** avoids scratches on the cathode front surface.

• Confirmation of cathode properties improvement applying **multiwavelengths** technique during cathode growth

• At **FNAL** we produced and test successfully the production and exchange of cathode between preparation and transfer system.

• **LBNL** transport system (with NEG pump) will be shipped in the next days.
Conclusions

• New interface of the TTF cathode database
• Web interface for inserting data into the database (rod, plug, cathodes, etc.) under development

Some proposals for the future

• Test of “special cathodes” for emittance measurement
  • polluted cathodes
  • ad-hoc cathodes (checking the $E_g + E_a$ energy threshold evolution with multiwavelength diagnostic during deposition)
• Test of multialkaly telluride (i.e. KCsTe)
• Test of integrated NEG-Ion Getter Pump (NEXTorr) on a transport box.