A HIGHLY REFLECTING NON-CONDUCTIVE FOIL

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- THE PROBLEM
- THE SOLUTION
- FIRST PRODUCTION
- PRODUCTION PROBLEMS
- FINAL COMMENTS

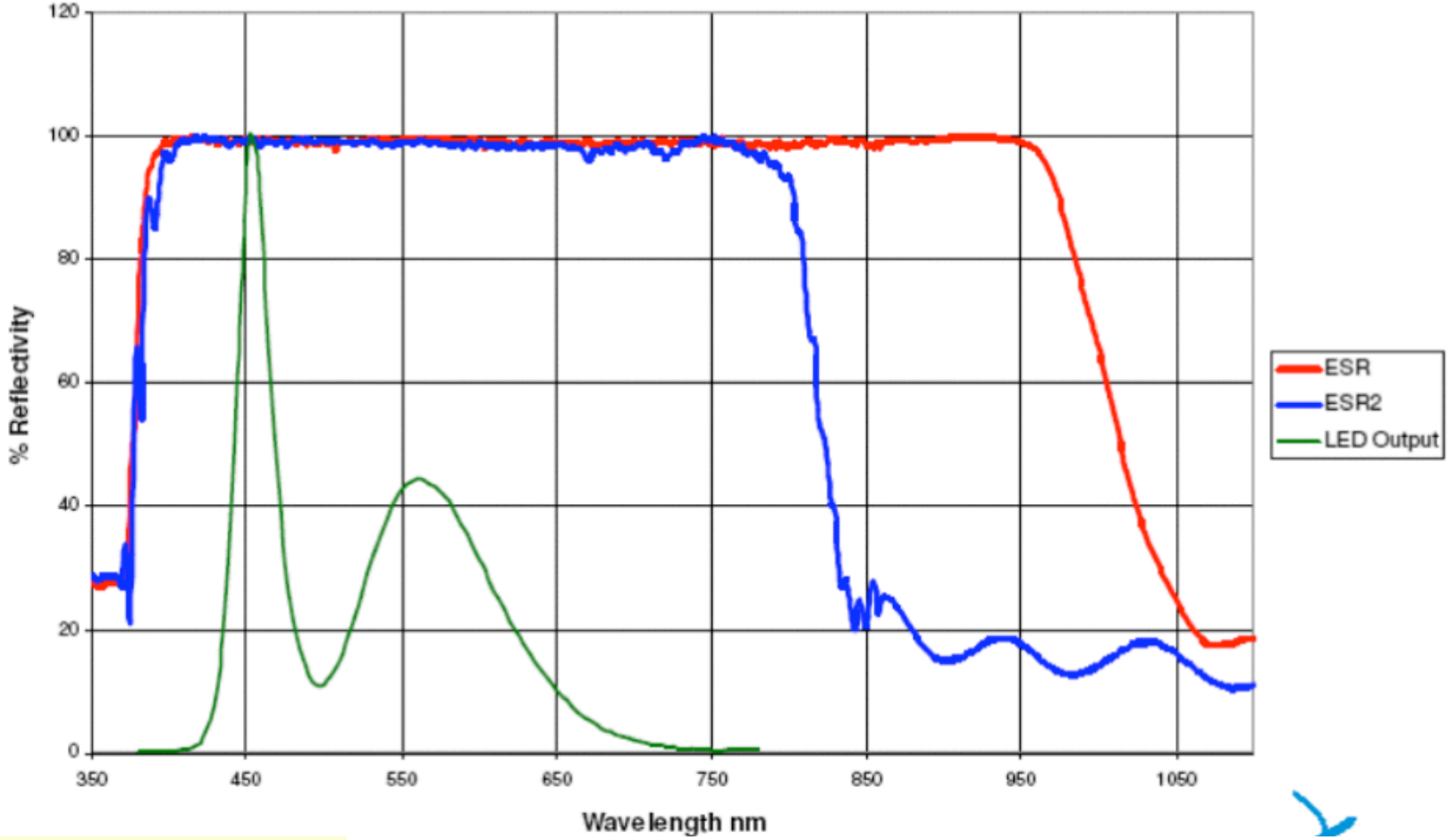
THE PROBLEM

- NEED OF A NON-CONDUCTIVE REFLECTOR WHEN WORKING IN HV ENVIRONMENTS
  FOR EXAMPLE WINSTON CONES FOR HPD, PMTS WITH HIGH CATHODE VOLTAGE

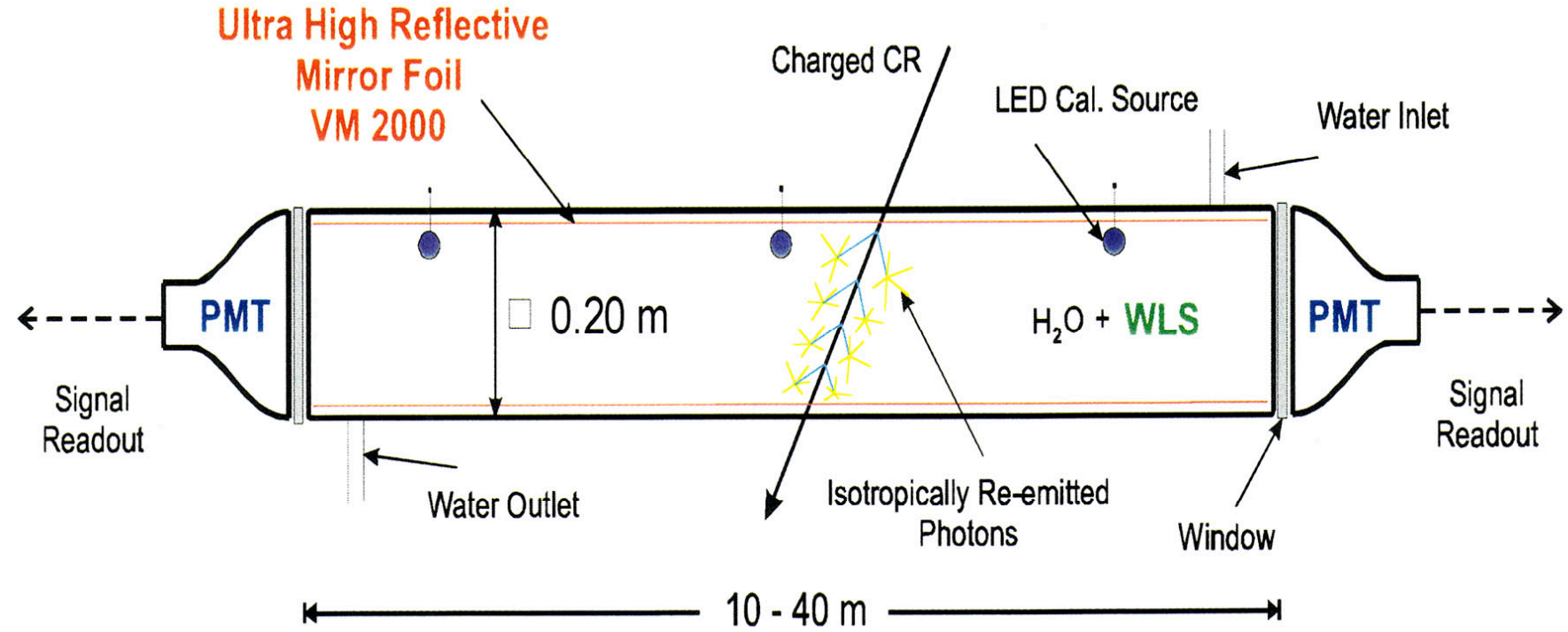
- HIGHEST POSSIBLE EFFICIENCY LIGHT PIPING
  FOR EXAMPLE FOR WINSTON CONES IN AIR CHERENKOV TELESCOPES OR READING OUT LONG SCINTILLATORS

- VERY THIN REFLECTORS IN DENSE SCINTILLATOR MATRIX PACKAGES FOR PET

THE COMPANY 3M PRODUCES A DIELECTRIC REFLECTOR FOIL WITH THE NAME VIKUITI
THIS FOIL HAS A REFLECTIVITY UP TO 98-99%

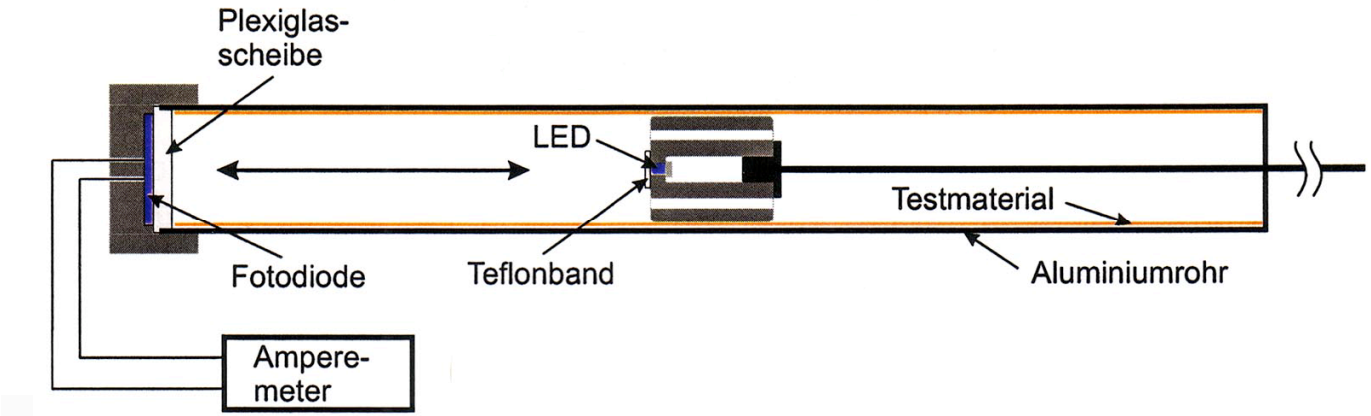


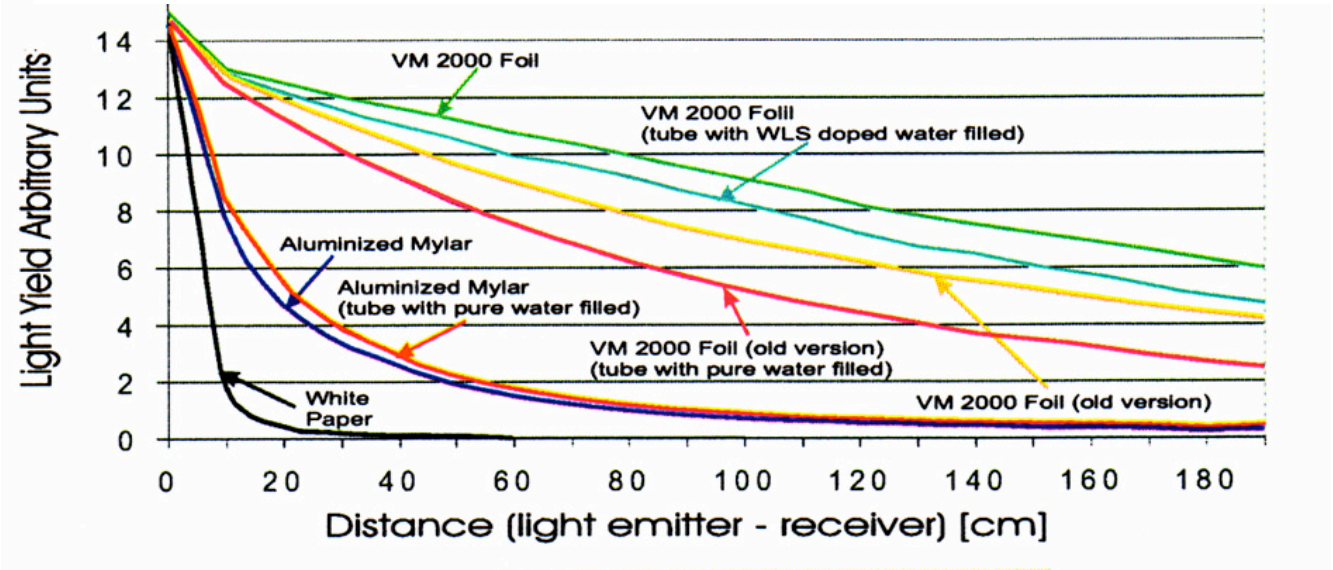
UNFORTUNATELY A CUTOFF AT 385 nm, EXCLUDES MANY APPLICATIONS


Ultra High Reflective
Mirror Foil
VM 2000
Charged CR
LED Cal. Source
Water Inlet
PMT
0.20 m
H_2O + WLS
PMT
Signal
Readout
Signal
Readout
Water Outlet
Isotropically Re-emitted
Photons
Window
10 - 40 m

An important test: how far can one transport light (emitted by an isotropic radiator) in a long tube

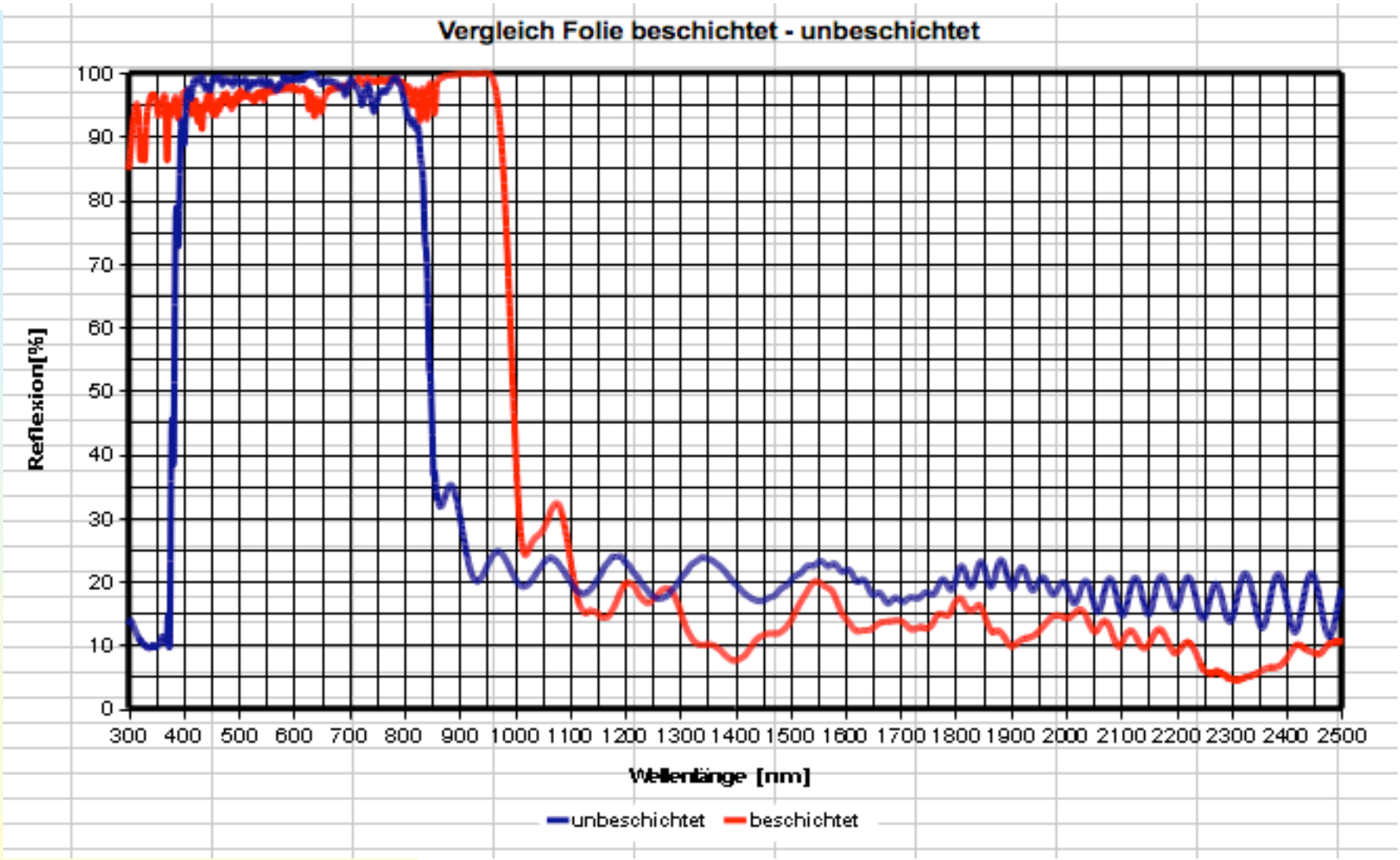
Use of a 200 cm long tube of 2.5 cm Ø. Tube lined with various specular and diffuse reflectors. At one end a PIN photodiode was mounted to measure the signal. An LED with a diffusor cap was moved along the tube. For part of the studies the tube was filled with clear water. Note poor performance of diffuse reflector and aluminised Mylar (R≈90%)
The latest version of the dielectric mirror VM2000 from 3M was found to be adequate and used in the following tests





HOW TO EXTEND THE HIGH REFLECTIVITY DOWN TO 300 nm ??

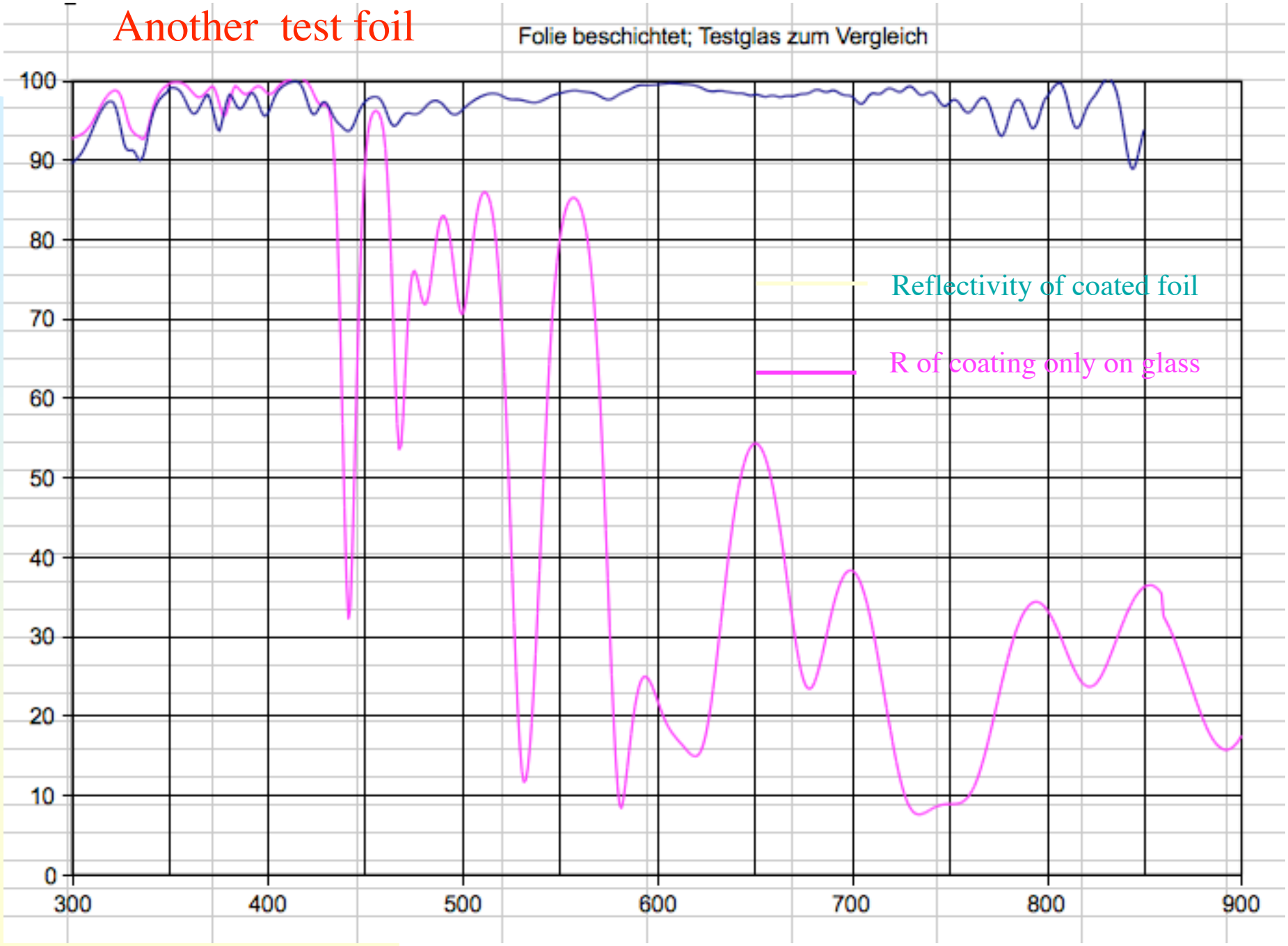
- EVAPORATE MULTILAYER DIELECTRIC COATING TO ADD HIGH REFLECTIVITY BETWEEN 300 AND 385 nm
- PROBLEM: FOIL DOES ONLY STAND TEMPERATURES UP TO 120°C
- FIRST DEVELOPMENT FAILED WITH SiO_2+ HFO_2 LAYERS
- FINALLY, A COMPANY WAS FOUND THAT COULD DO IT BTE
- MULTILAYERS OF SiO_2 + Ta_2O_5
- STILL NOT PERFECT DUE TO SLIGHT OVERHEATING OF FOIL



BLUE: R OF ORIGINAL 3M FOIL

RED: R OF OVERCOATED 3M FOIL

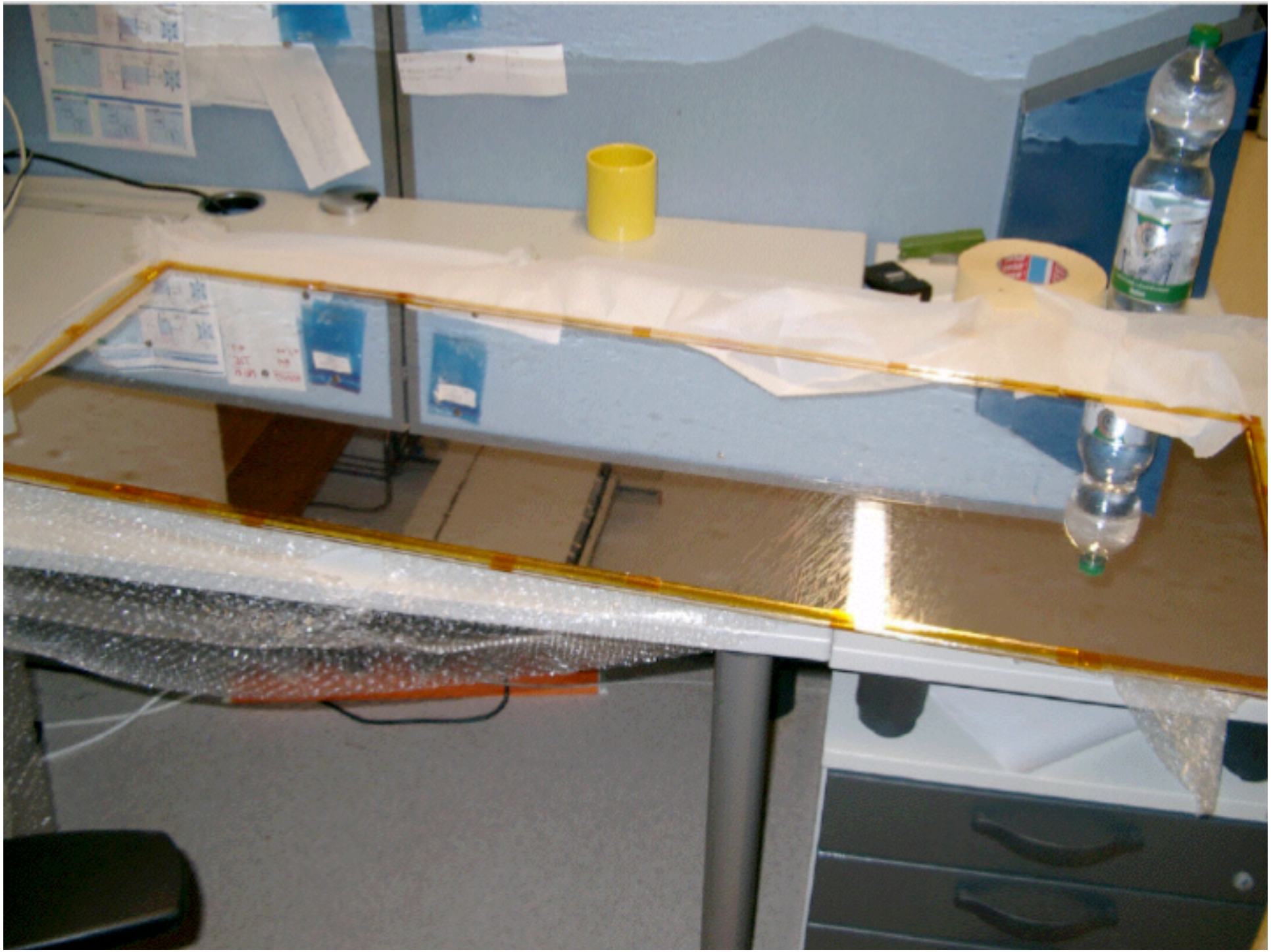
Another test foil

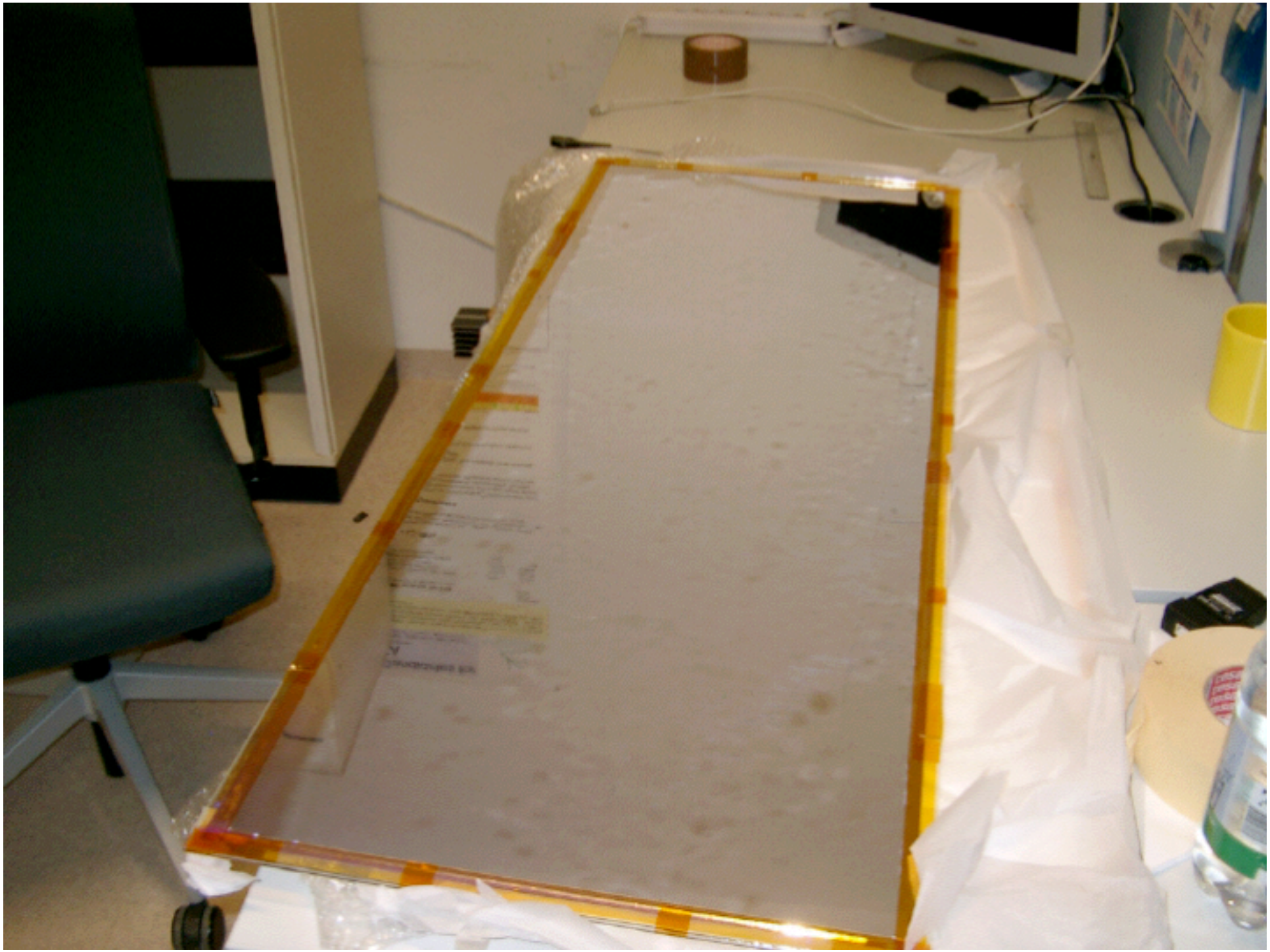


FIRST LARGE AREA PRODUCTION

45 x 90 cm

The coated foil shows some fine wrinkles due to slight Overheating. Does not affect the planned application for Winston cones for the CTA LSTs





Final comments

- Succeeded to produce a non-conductive reflector down to 300 nm
- Reflectivity <R> 96 -97%
- Foil can be bend
- Foil 65 micron thick
- Surface structure needs still to be improved
- Can make sample size up to 45x90 cm
- Many thanks to Maxim Shayduk who participated in the developments up to 2010