Comparison of Measured Integrated Reflectivity with Spectral Parameters

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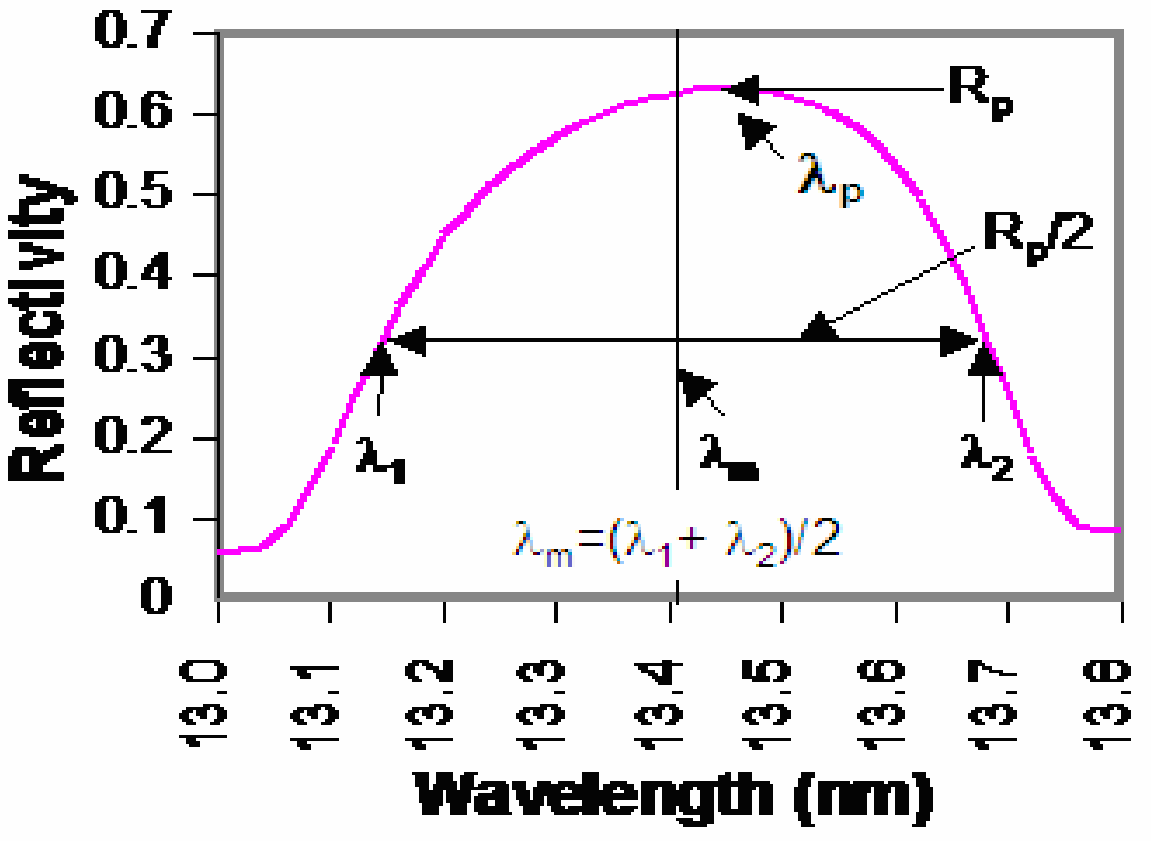
Misconceptions and facts

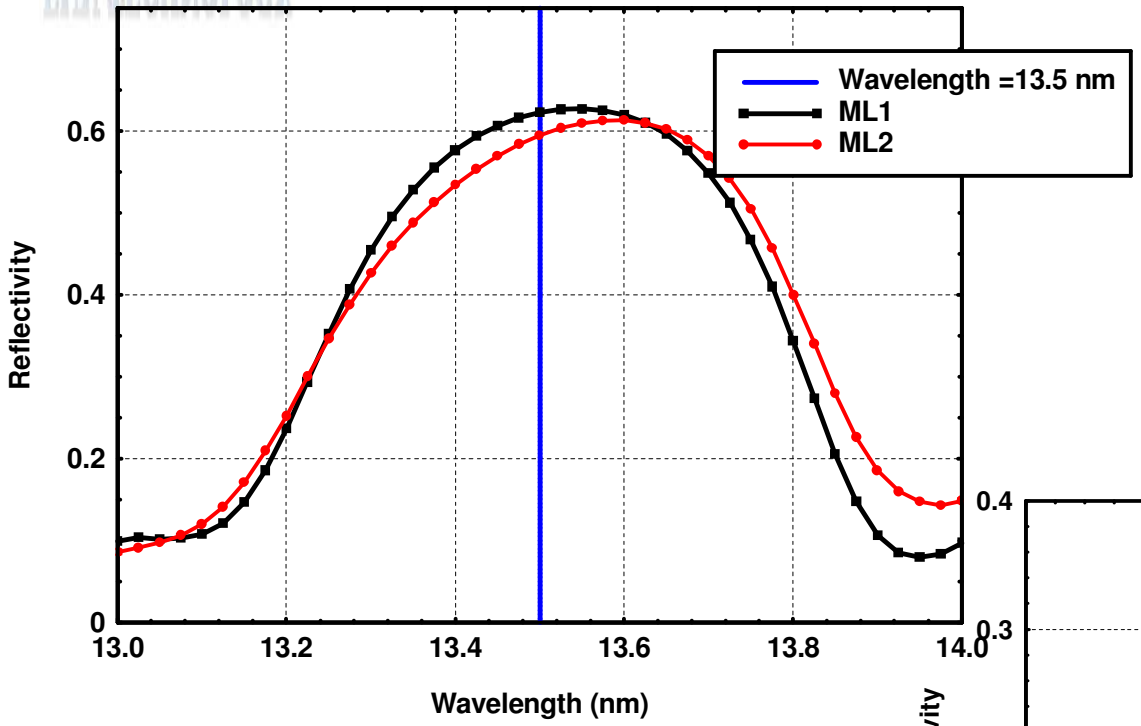
- Misconceptions
  - Reflectivity parameters are difficult to measure with required accuracy
- Facts
  - Reflectivity measurements are very easy to perform
  - Takes about 30 seconds per measurement
  - Currently, we can measure R with 3σ of 0.05% and lambda 3σ of 0.0005nm

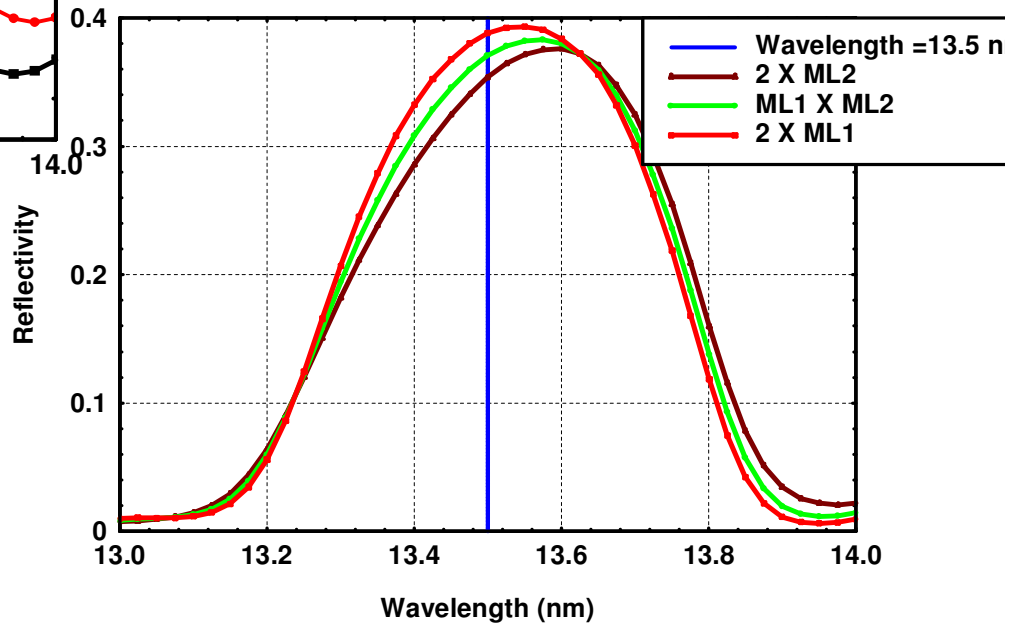
These values far exceed HVM requirements

Definition of peak EUV reflectivity (R_p) and median wavelength (λ_m).



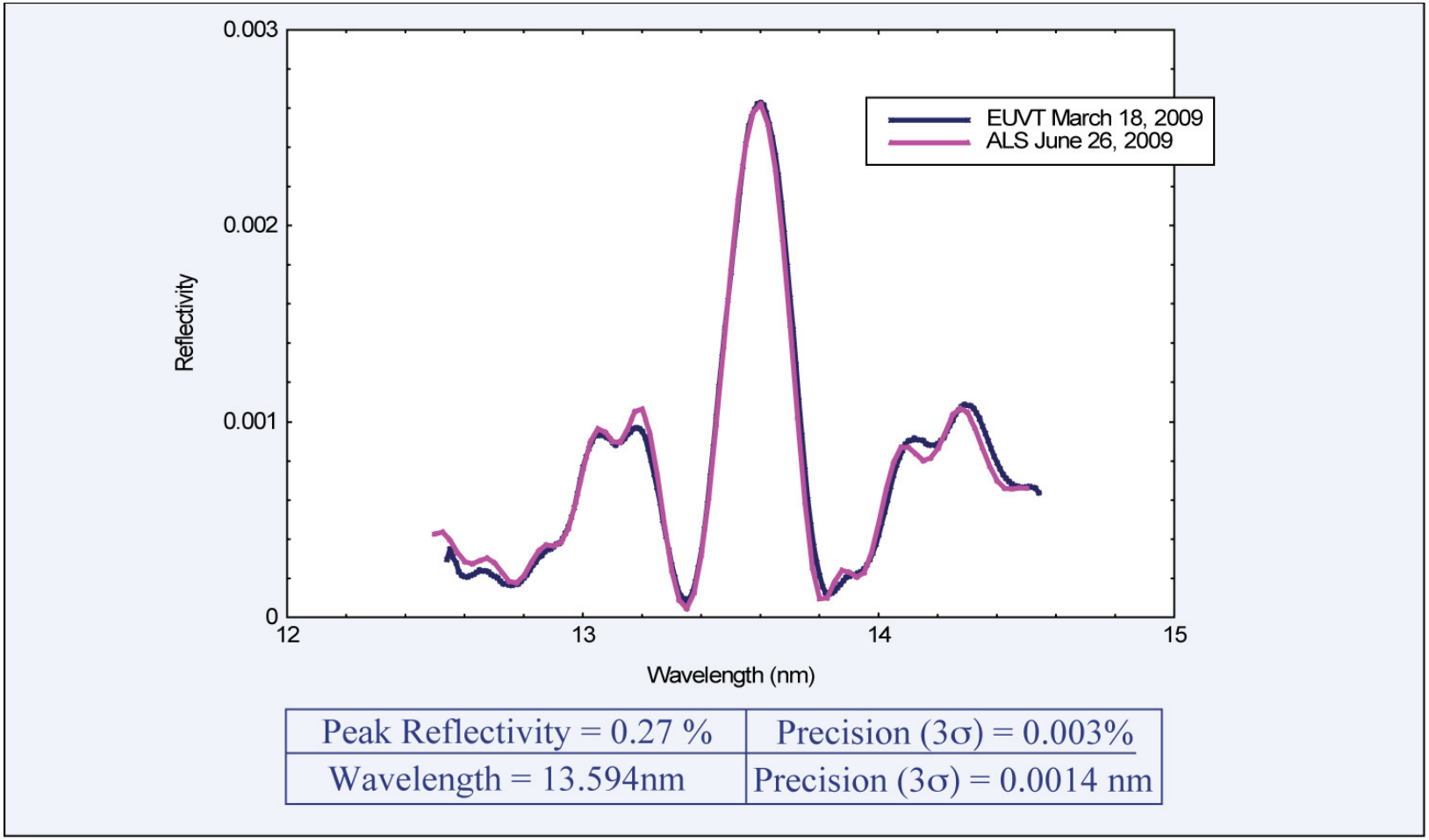
Reflectivity measurements: Two multilayers





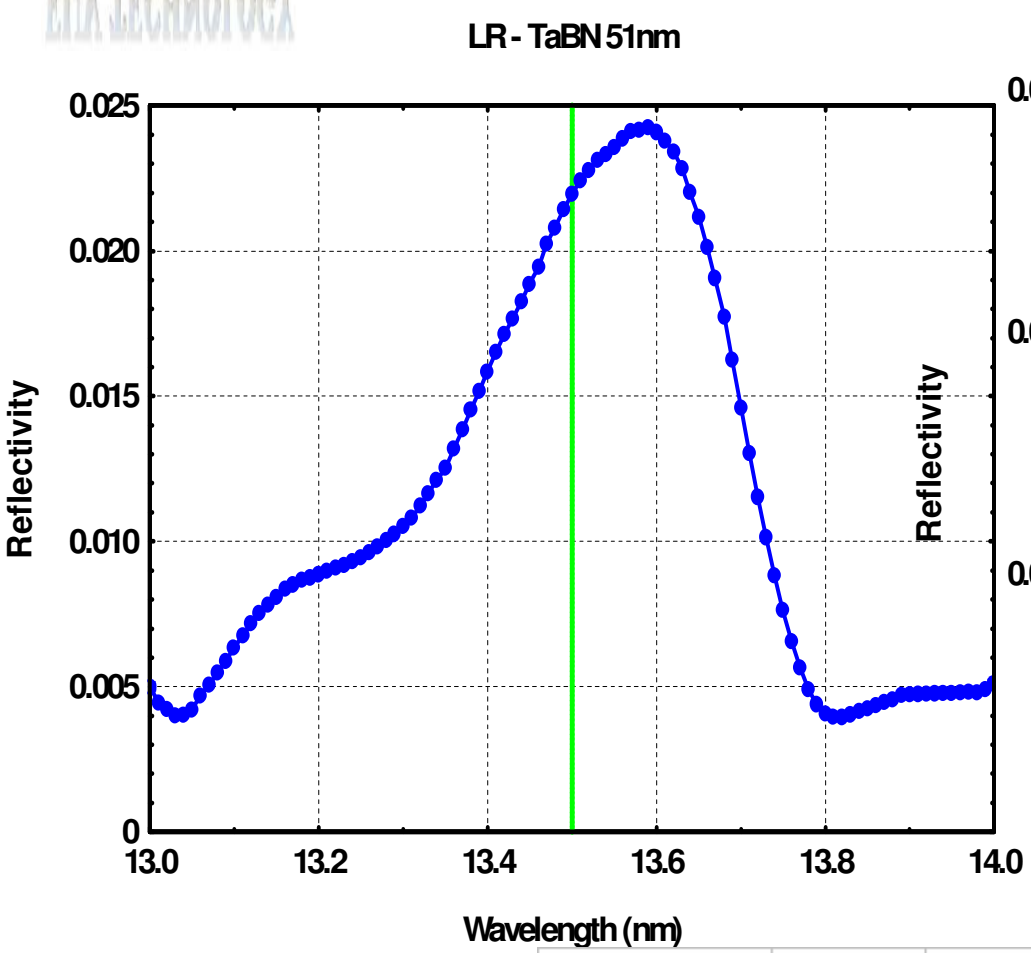
	Rp %	λm (nm)	W (nm)	Int. R
ML1	62.34	13.537	0.579	0.3715
ML2	61.37	13.532	0.611	0.3817

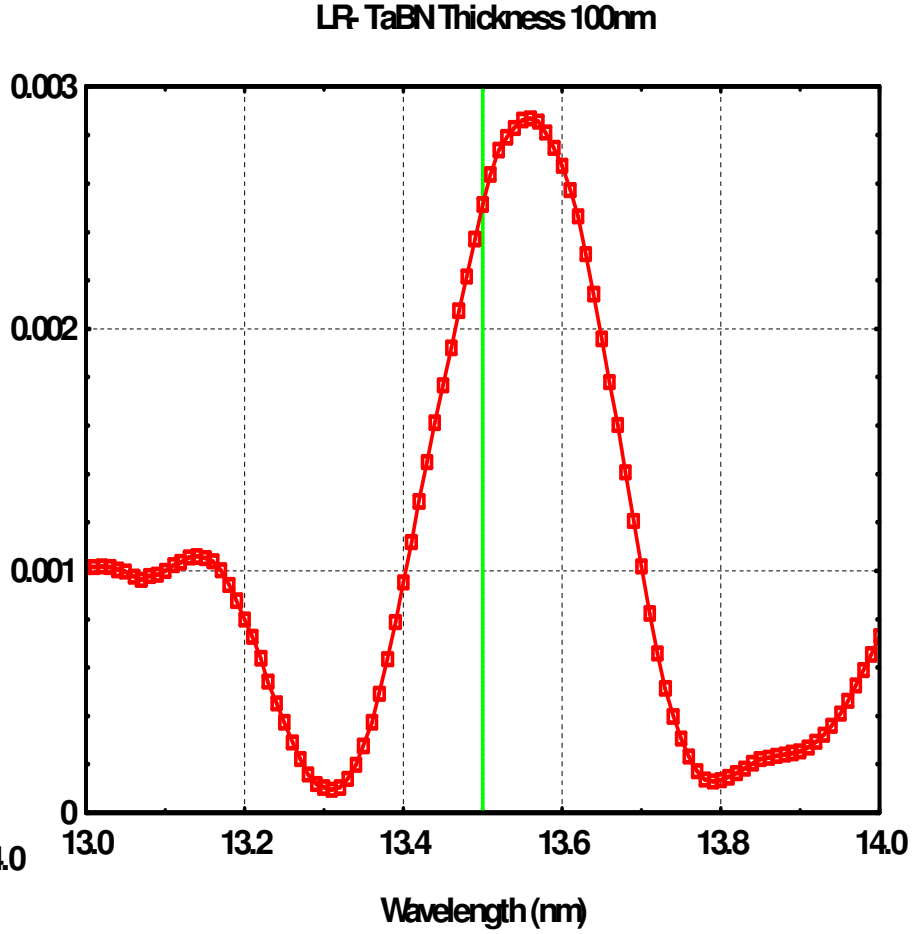
Absorber Plate (100nm La-TaBN): Measured Reflectivity



Peak Reflectivity = 0.27 %	Precision (3σ) = 0.003%
Wavelength = 13.594nm	Precision (3σ) = 0.0014 nm

Absorber Data: Rp 2.5% and 0.3%





	Rp %	λm (nm)	W (nm)	Int. R
La-TaBN 51 nm	2.449	13.529	0.372	0.011500
La-TaBN 100 nm	0.288	13.549	0.250	0.001008
Ratio 51nm/100nm	8.514			11.409

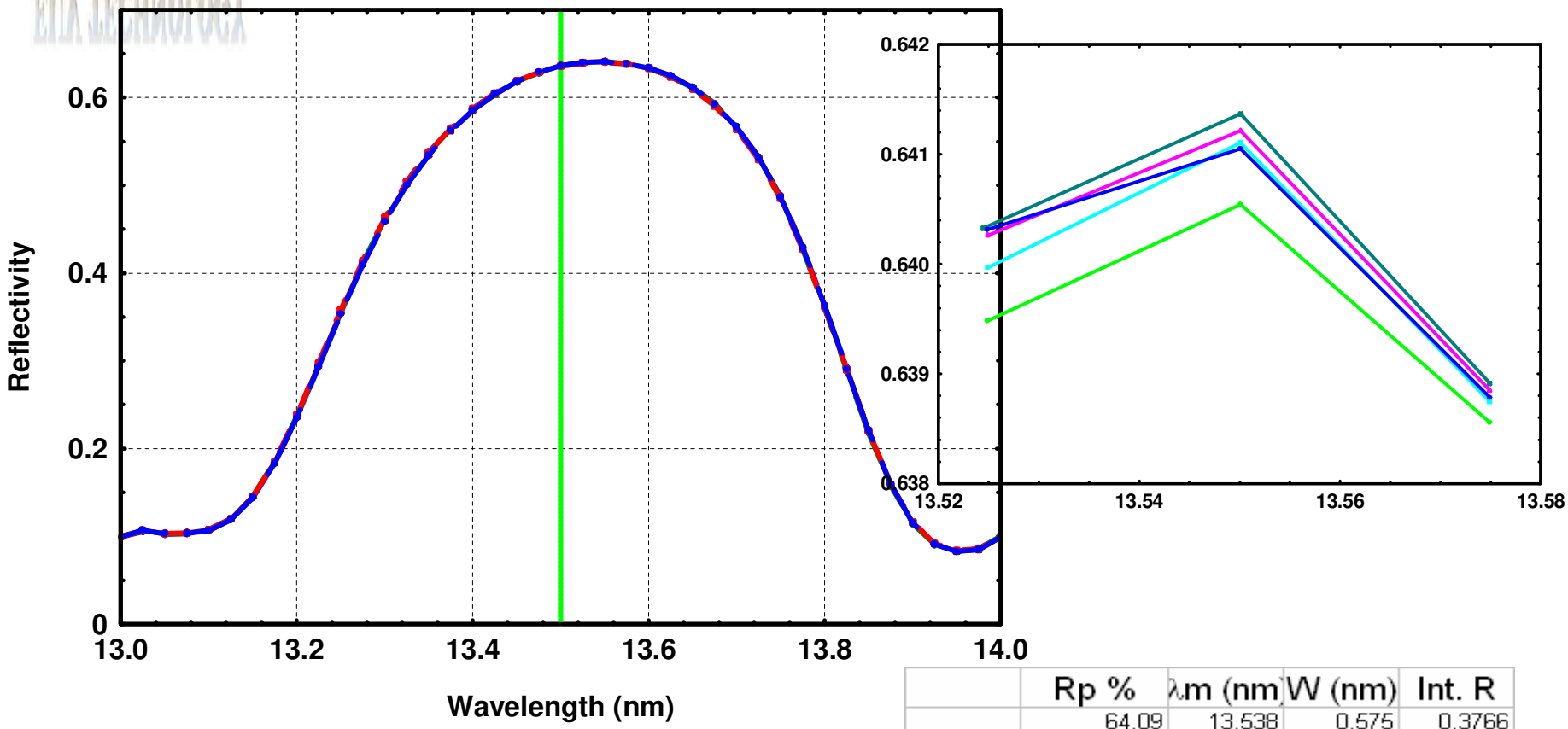
Required Performance for the HVM Reflectometer

Measurement Performance	
EUV Peak reflectivity precision for $R_p > 2\%$ absolute	$3\sigma \leq 0.07\%$ absolute
EUV Peak reflectivity accuracy for $R_p > 2\%$ absolute	$3\sigma \leq 0.10\%$ absolute
EUV Peak reflectivity precision for $R_p < 2\%$ absolute	$3\sigma \leq 0.01\%$ absolute
EUV Peak reflectivity accuracy for $R_p < 2\%$ absolute	$3\sigma \leq 0.05\%$ absolute
Minimum wavelength range	10.5nm to 15.5nm
Minimum wavelength resolution ($\Delta\lambda/\lambda$)	500
EUV median wavelength precision	$3\sigma \leq 0.002$ nm
EUV median wavelength accuracy	$3\sigma \leq 0.003$ nm
Maximum clear space required for measurement	1mm x 1mm

Additional features:
Absolute (internal) reflectivity and wavelength calibration
Capability to find pattern location to be measured.

Requirements for the mask are based on the illumination uniformity error budget

5 measurements on a very good ML



	Rp %	λm (nm)	W (nm)	Int. R
	64.09	13.538	0.575	0.3766
	64.07	13.538	0.575	0.3768
	64.12	13.537	0.574	0.3765
	64.10	13.537	0.576	0.3769
	64.10	13.538	0.575	0.3765
Average	64.09	13.538	0.575	0.3767
3 sigma	0.059	0.001	0.002	0.001
% 3 sigma	0.09	0.007	0.286	0.137

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Summary

	Rp %	λm (nm)	W (nm)	Int. R	Nomalized Int. R
	64.09	13.538	0.575	0.3766	64.09
ML1	62.34	13.537	0.579	0.3715	63.22
TaBN 51 nm	2.449	13.529	0.372	0.011500	1.96
TaBN 100 nm	0.288	13.549	0.250	0.001008	0.17

Normalized Integrate R does not correlate directly with the spectral parameters and highly tool dependence.