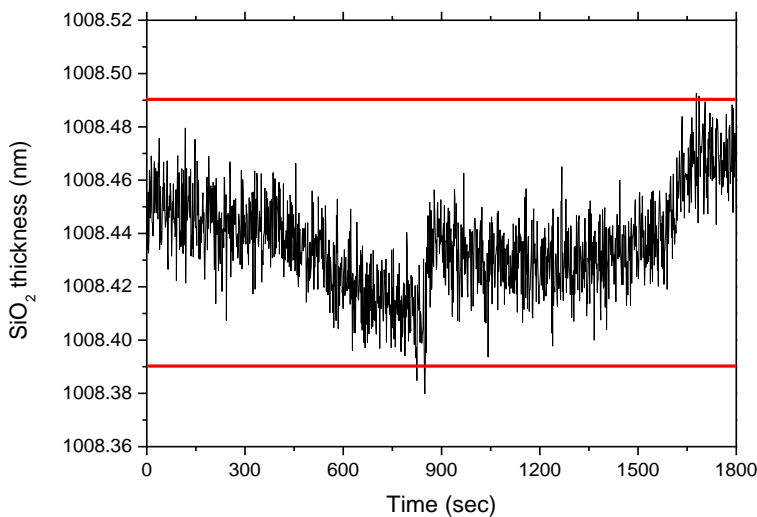


## PRECISION, MEASUREMENT STABILITY

Thanks to the robust design and high quality of optical components FR-tools provide with measurements with very high precision and measurement stability. In the following plots the precision and measurement stability are illustrated for:

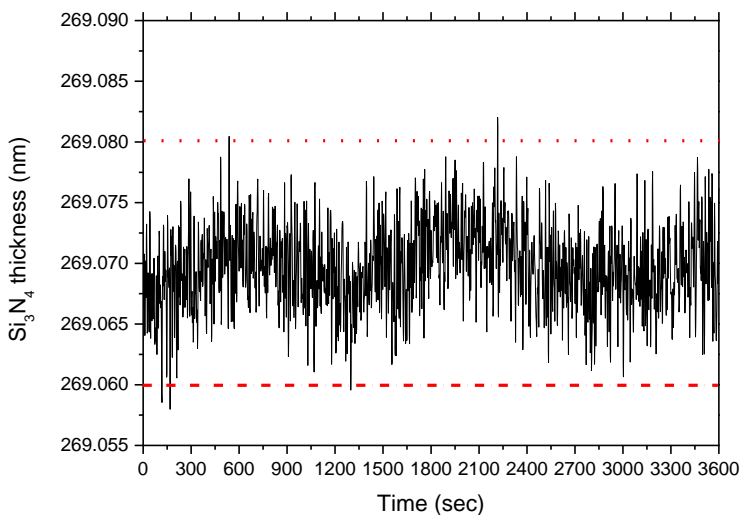
- 1 $\mu$ m thick thermal silicon dioxide film on Si wafer
- 265nm thick Si<sub>3</sub>N<sub>4</sub> layer deposited via LPCVD on Si wafer.

All measurements were performed during at an exhibition on a standard table without any precautions on environmental light and temperature stability.



**SiO<sub>2</sub> film thickness measurement over a period of 30mins. Mean SiO<sub>2</sub> film thickness value is:**

**1008.44nm  $\pm$ 0.05nm.**

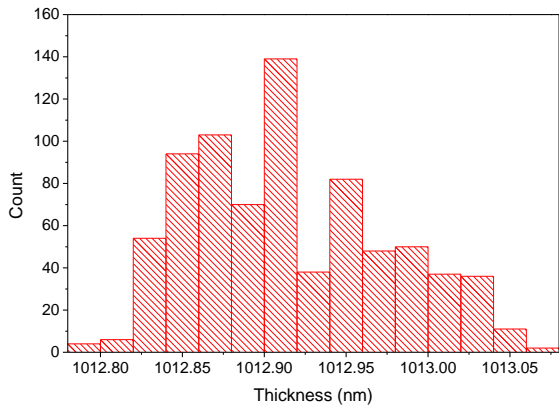


**Si<sub>3</sub>N<sub>4</sub> film thickness measurement over a period of 60min. Mean Si<sub>3</sub>N<sub>4</sub> film thickness value is:**

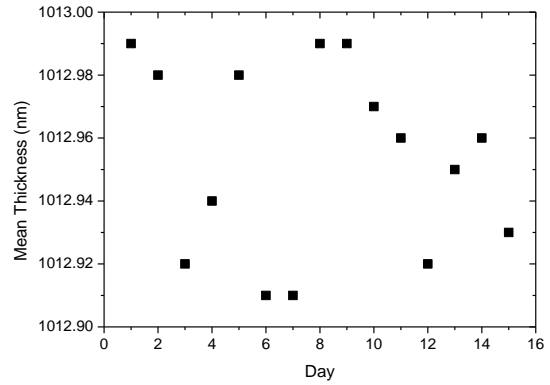
**269.70nm  $\pm$ 0.01nm.**

Furthermore the long-term stability over a period of 15 sequential days was studied in the case of SiO<sub>2</sub> layer on Si wafer. These measurements were acquired in a standard laboratory environment. In the following

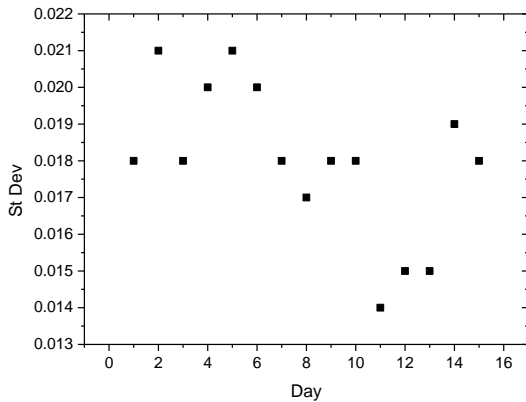
figures the related stability results are presented for the SiO<sub>2</sub> layer. Similar results were recorded for the Si<sub>3</sub>N<sub>4</sub> case.



**Histogram showing the SiO<sub>2</sub> thickness measurements over a period of 3 hours**



**Mean thickness values for a period of 15 sequential days. Each point is the thickness value from 360 measurements**



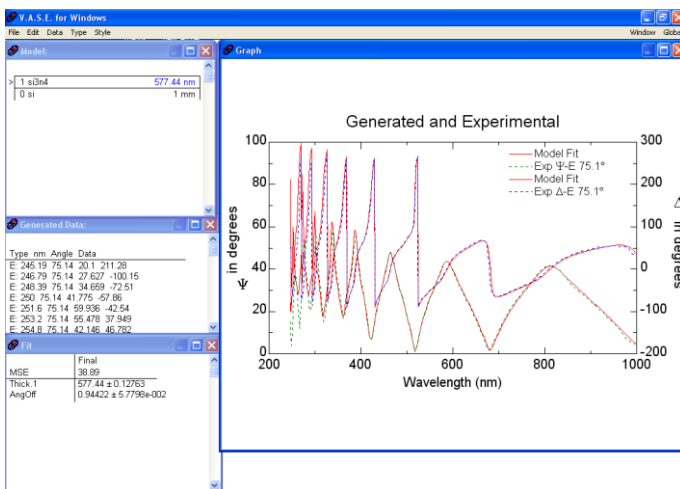
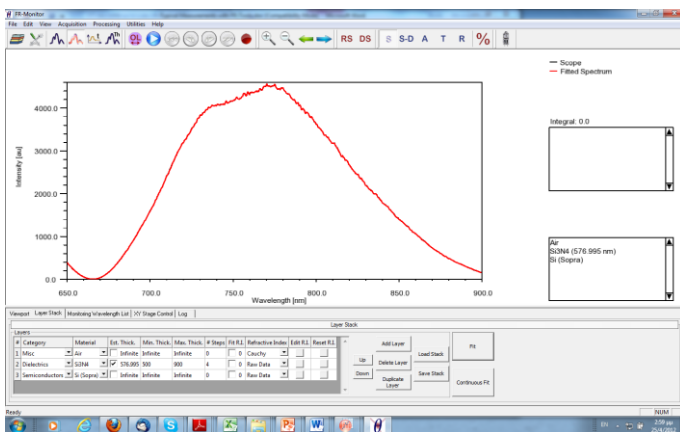
**Standard deviation values for the thickness measurements of the SiO<sub>2</sub> layer**

In the following table the results related to the mean thickness and standard deviations are listed.

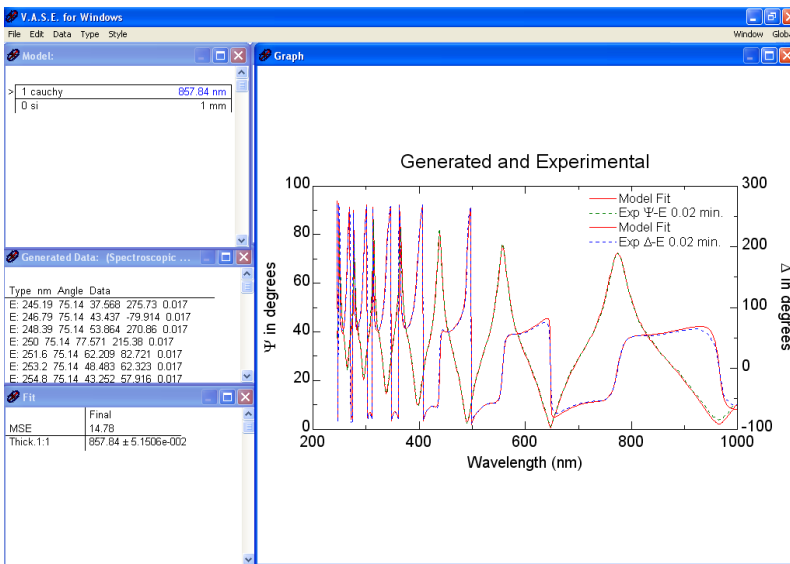
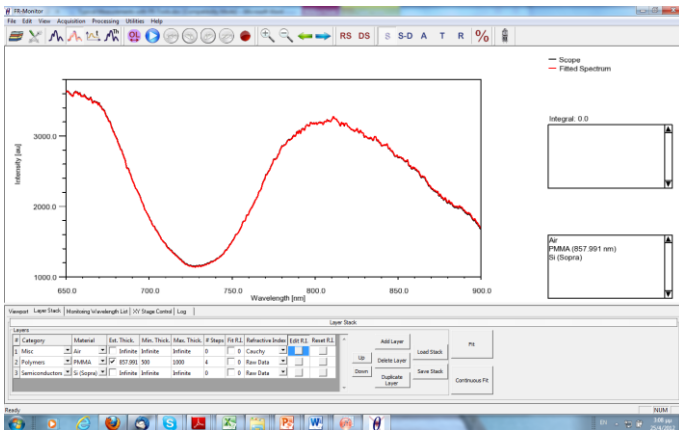
	SiO <sub>2</sub> on Si wafer
<b>Mean value over 3 hours (typical)</b>	1012.91-1013.00nm
<b>Standard deviation of the mean value over 3 hours (max)</b>	0.08nm
<b>Mean value over 15 days</b>	1012.95nm
<b>Average of standard deviation of mean value over 15 days</b>	0.06nm
<b>2*Standard-Deviation of daily average over 15 days</b>	0.06nm

## ACCURACY

Film thickness calculation accuracy has been evaluated against independent measurements from spectroscopic ellipsometry and electrical (capacitive) measurements. In both cases the accuracy was better than 1nm. In the following screenshots the measurements from FR-tools and calibrated spectroscopic ellipsometers are compared for Si<sub>3</sub>N<sub>4</sub> and PMMA films on Si wafer. In both cases, the difference between the two measurements is less than 0.5nm for nominal thicknesses of 577nm and 857nm respectively.



Sample: Si<sub>3</sub>N<sub>4</sub> deposited by LPCVD on Si



Sample: PMMA spin coated on Si.

## Comparison study for thin SiO<sub>2</sub> and Si<sub>3</sub>N<sub>4</sub> layers on Si wafer

Sample	Ellipsometry	FR-pOrtable
1	12.0nm	11.8nm
2	10.2nm	10.0nm
3	8.2nm	8.0nm
4	6.3nm	6.5nm
T1	50.0nm	50.1nm
T2	41.7nm	41.9nm
T3	30.5nm	30.6nm
T4	20.0nm	20.1nm
T5	15.9nm	16.1nm