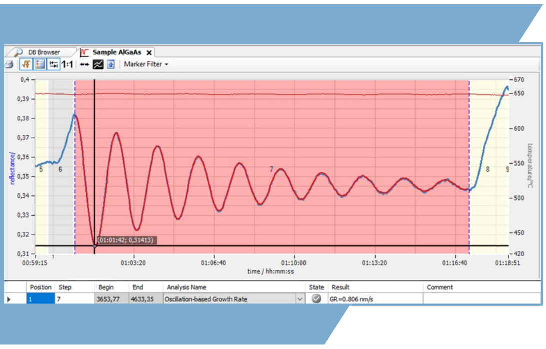
MEMBER OF THE NYNOMIC GROUP

vol #3

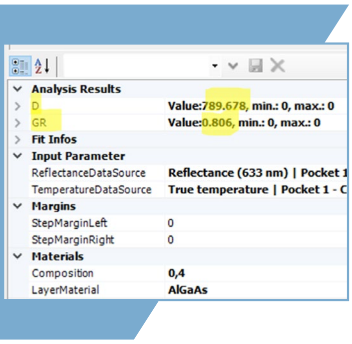
EpiNet®'s "Algorithm Deep-Dive" series

Learn how to analyze your in-situ data most efficiently



Position	Step	Begin	End	Analysis Name	State	Result	Comment
1	7	3653,77	4633,35	Oscillation-based Growth Rate		GR=0.806 nm/s	

Fig. 1: Analysis screen of EpiNet® applying the "Oscillation-based Growth Rate" fit allowing deducing the growth rate and film thickness of thick layers based on pre-known refractive index n and extinction coeficient k. Here, the deposited material was AlGaAs and the respective values of n and k were taken from the EpiNet database. Note that the fit was exclusively applied to the process step marked in red.



Analysis Results	
D	**Value:789.678, min.: 0, max.: 0**
GR	**Value:0.806, min.: 0, max.: 0**
Fit Infos	
Input Parameter	
ReflectanceDataSource	**Reflectance (633 nm) | Pocket 1**
TemperatureDataSource	**True temperature | Pocket 1 - C**
Margins	
StepMarginLeft	0
StepMarginRight	0
Materials	
Composition	**0,4**
LayerMaterial	**AlGaAs**

Fig. 2: Results window displaying the values for the thickness (D; in nm), and the growth rate (R; in nm/s). Additionally, the selected growing materialis listed in the lower section.

Algorithm profile

Algo name: The "Oscillation-based Growth Rate"

Short description:

- In contrast to the "NKR adv virtual layer fit" and the "NKR Fit on substrate/calibration-layer-corrected reflectance" algorithm, the **"Oscillation-based Growth Rate"** fit makes use of the known refractive index n and the extinction coefficient k to deduce the growth rate r during epitaxial growth from reflectance transients obtained by LayTec's EpiTT and EpiCurve® TT.
- It is fit a convenient way to check whether a thick layer (multiple full oscillations within the respective growth step) grows in an "well-behaved" and expected manner, i.e. at a constant growth rate and with known n and k from EpiNet's database.
- The algorithm is also closely related to the **"Oscillation Period"** which is an even more simplistic but fast fit which merely determines the period time of one full oscillation as well as the number of such oscillations within the selected layer. Both fits rely on a purely (potentially damped) sinusoidal oscillation behavior.

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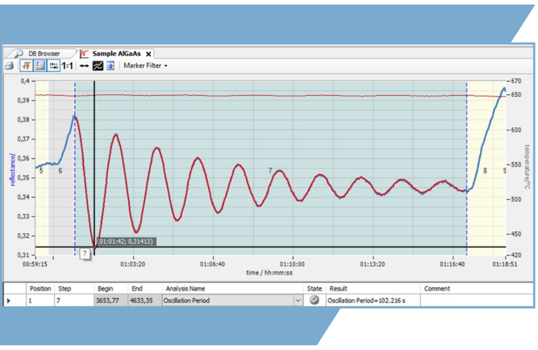
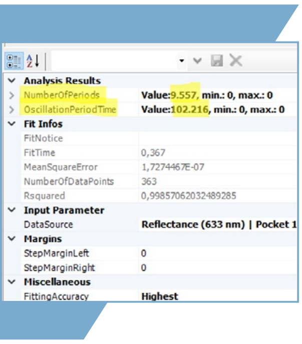


	Position	Step	Begin	End	Analysis Name	State	Result	Comment
▸	1	7	3653,77	4633,35	Oscillation Period	✓	Oscillation Period=102.216 s	

Fig. 3: Analysis screen of EpiNet® applying the “Oscillation Period” fit allowing for determining the oscillation period and the number of oscillations within the selected step based on a damped sinusoidal fit. Note that the fit was exclusively applied to the process step marked in red.



Analysis Results	
NumberOfPeriods	**Value:9.557, min.: 0, max.: 0**
OscillationPeriodTime	**Value:102.216, min.: 0, max.: 0**
Fit Infos	
FitNotice	
FitTime	0,367
MeanSquareError	1,7274467E-07
NumberOfDataPoints	363
Rsquared	0,99857062032489285
Input Parameter	
DataSource	**Reflectance (633 nm) | Pocket 1**
Margins	
StepMarginLeft	0
StepMarginRight	0
Miscellaneous	
FittingAccuracy	**Highest**

Fig. 4: Results window displaying the values for the oscillation period and the number of oscillations within the process step determined based on a damped sinusoidal fit.

Algorithm profile

Usage Ideas and Alternatives:

- The “Oscillation-based Growth Rate” fit is suitable for thick layers of known materials and a sinusoidal reflectance transient.
- It is usually a good choice for quickly verifying whether reasonable results are obtained for a well-known growth process. Here, in particularly the appropriateness of the material parameters n and k are tested for consistence.
- For detailed growth rate analyses or even unknown materials properties the NKR adv Virtual Layer Fit is usually a better alternative.
- The most simplistic “Oscillation Period” fit is usually a suitable first step for approaching the analysis of new materials of unknown n and k in order to verify whether a “well-behaved” (i.e. damped sinusoidal) growth behavior is applicable for a given layer.

User instructions can be found in the manual and can be obtained via info@laytec.de.

Reference data is available within EpiNet®.