



# Xenometrix

*The Power to Change Energy Into Information*

**МЕТОД ФУНДАМЕНТАЛЬНЫХ  
ПАРАМЕТРОВ – АНАЛИЗ БЕЗ  
КАЛИБРОВОЧНЫХ СТАНДАРТОВ.  
ПРОГРАММНЫЙ ПАКЕТ XRS-FP**

*Bio Engineering Group* 

## ЧТО ТАКОЕ XRS-FP?

---

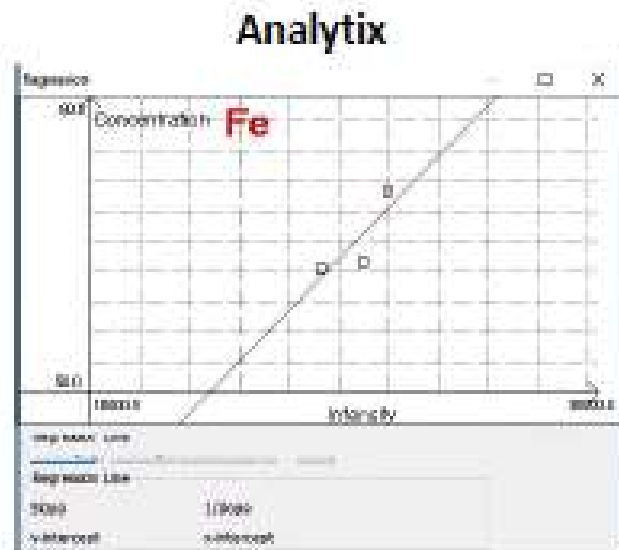
Самостоятельный программный пакет профессионального применения метода фундаментальных параметров, который используется для количественного анализа спектров, полученных с помощью программного пакета AnalytiX.

## КАК ЭТО РАБОТАЕТ?

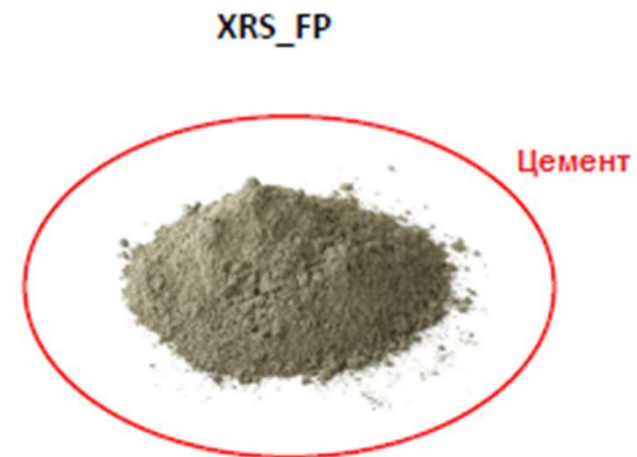
---

Модель фундаментальных параметров базируется на физических уравнениях, устанавливающих корреляцию между интенсивностью сигнала и концентрацией элемента, дающего этот сигнал

# В ЧЁМ РАЗНИЦА МЕЖДУ XRS\_FP и AnalytiX?



Калибровка по каждому элементу



Калибровка образца целиком

Constituent	Mass Fraction (%)	Constituent	Mass Fraction (%)
SiO <sub>2</sub>	22.26 ± 0.15	K <sub>2</sub> O	1.228 ± 0.029
Al <sub>2</sub> O <sub>3</sub>	7.668 ± 0.061	TiO <sub>2</sub>	0.1665 ± 0.0030
Fe <sub>2</sub> O <sub>3</sub>	3.49 ± 0.11	P <sub>2</sub> O <sub>5</sub>	0.1499 ± 0.0077
CaO	57.35 ± 0.34	Mn <sub>2</sub> O <sub>3</sub>	0.1947 ± 0.0016
MgO	3.861 ± 0.077	Na <sub>2</sub> O	0.036 ± 0.004
SO <sub>3</sub> <sup>2-</sup>	3.356 ± 0.069	Cu <sub>2</sub> O	0.0788 ± 0.0029
Na <sub>2</sub> O	0.79 ± 0.007	ZnO	0.0489 ± 0.0028

## КОГДА НУЖЕН XRS-FP?

---

Когда нет калибровочных стандартов

или

стандартов слишком мало

## ЧТО ДАЁТ XRS-FP?

---

- Анализ без калибровочных стандартов
- Точный анализ со всего одним стандартом
- Алгоритм коррекции матричных влияний

# ПОЛЬЗОВАТЕЛЬСКИЙ ИНТЕРФЕЙС

**Acquire**    500 kV/100 μA    HV: 60 (4->200) μA: 10 (1->2000) Preset: 120    Time: 120.0    3DT: 0.0    X: 0    Y: 0    Z: 0

**Specimen Component Table:**

#	Component	Type	Conc	Error	Units	Mod%	Error
2	Al2O3	Calc	0.0000	0.0000	wt %	0.0000	0.0000
3	CaO	Calc	0.0000	0.0000	wt %	0.0000	0.0000
4	Fe	Calc	0.0000	0.0000	wt %	0.0000	0.0000
5	MgO	Calc	0.0000	0.0000	wt %	0.0000	0.0000
6	Pb	Calc	0.0000	0.0000	wt %	0.0000	0.0000
7	Zn	Calc	0.0000	0.0000	wt %	0.0000	0.0000

**Thickness Information:**

Layer							Normalize	
Thick	Type	Error	Units	Density	Foatd	OK	Total	
0.000	Blank	0.000	mg/cm2	0.000		<input checked="" type="checkbox"/>	100.00	

**Global Threshold Settings:**  
in-signa: 2.000    Clear    Conc Method:

**Element Table:**     Normal     Coefficients

#	Element		Cond	Measurement							Threshold		Intensity	Ratio	ROI (keV)		Chi2	Quant	Calibration
	Elem	Line		Code	Intensity	Error	Backgr	Conc	Error	NDL	Atom%	Value			Conc	Method			
4	Si	Kα	1	0.000	0.00	0.00	0.000	0.000	0.0000	0.000	0.000		Gaussian	None	0.000	0.000	0.00	FP	0.00
5	Ca	Kα	1	0.000	0.00	0.00	0.000	0.000	0.0000	0.000	0.000		Gaussian	None	0.000	0.000	0.00	FP	0.00
6	Fe	Kα	1	0.000	0.00	0.00	0.000	0.000	0.0000	0.000	0.000		Gaussian	None	0.000	0.000	0.00	FP	0.00
7	Zn	Kα	1	0.000	0.00	0.00	0.000	0.000	0.0000	0.000	0.000		Gaussian	None	0.000	0.000	0.00	FP	0.00
8	Pb	Lα	1	0.000	0.00	0.00	0.000	0.000	0.0000	0.000	0.000		Gaussian	None	0.000	0.000	0.00	FP	0.00

**Measurement & Processing Conditions:**     Measurement     Processing

Code	XRay Source					Detector			Chamber	Time (sec)		Monitor
	Target	Filter	Thick(μm)	kV	μA	Type	Filter	Thick(μm)		Absor	Preset	
1	Pb	None	0.00	40.0	10.0	Si-drift	None	0.00	Vac	120.0	120.0	0.0

Status: D:\PPNSRFP\_MANUAL\8\_sfp.fr    [ 0 | 08 | 08 | 2048 | 20 | 31 | No | 1 ]

# ПОЛЬЗОВАТЕЛЬСКИЙ ИНТЕРФЕЙС

## Определение компонентов образца

The screenshot displays the XRF software interface with the following sections:

**Specimen Component Table:**

#	Component	Type	Conc.	Error	Units	Mole%	Error
2	Al2O3	Calc	0.0000	0.0000	wt.%	0.0000	0.0000
3	CaO	Calc	0.0000	0.0000	wt.%	0.0000	0.0000
4	Fe	Calc	0.0000	0.0000	wt.%	0.0000	0.0000
5	MgO	Calc	0.0000	0.0000	wt.%	0.0000	0.0000
6	Pb	Calc	0.0000	0.0000	wt.%	0.0000	0.0000
7	Zn	Calc	0.0000	0.0000	wt.%	0.0000	0.0000

**Thickness Information:**

Layer						Normalize		
Thick	Type	Error	Units	Density	Fixed	OK	Total	
0.000	Bulk	0.000	mg/cm2	0.000	<input type="checkbox"/>	<input checked="" type="checkbox"/>	100.00	

**Global Threshold Settings:**

n-sigma:  Clear Conc Method:

**Element Table:** Normal Coefficients

#	Element		Cond	Measurement							Threshold		Intensity	Ratio	ROI (keV)		Ch2	Quant	Calibration	
	Elem	Line		Intensity	Error	Backgr.	Cont.	Error	MDC	Atom%	Value	Conc			Low	High				Fl
4	Si	Kα	1	0.000	0.00	0.00	0.000	0.000	0.0000	0.000	0.000	0.000		Gaussian	None	0.000	0.000	0.00	FP	0.00
5	Ca	Kα	1	0.000	0.00	0.00	0.000	0.000	0.0000	0.000	0.000	0.000		Gaussian	None	0.000	0.000	0.00	FP	0.00
6	Fe	Kα	1	0.000	0.00	0.00	0.000	0.000	0.0000	0.000	0.000	0.000		Gaussian	None	0.000	0.000	0.00	FP	0.00
7	Zn	Kα	1	0.000	0.00	0.00	0.000	0.000	0.0000	0.000	0.000	0.000		Gaussian	None	0.000	0.000	0.00	FP	0.00
8	Pb	Lα	1	0.000	0.00	0.00	0.000	0.000	0.0000	0.000	0.000	0.000		Gaussian	None	0.000	0.000	0.00	FP	0.00

**Measurement & Processing Conditions:** Measurement Processing

Code	X-Ray Source				Detector				Chamber	Time (sec)		Monitor
	Target	Filter	Thick(um)	kV	uA	Type	Filter	Thick(um)		Atmos	Preset	
1	Rh	None	0.00	40.0	10.0	Grid	None	0.00	Vac	120.0	120.0	0.0

Status: D:\FPS\SI\FPF\_MANUAL\0\_slfp.rh | 0 | Off | Off | 2040 | 20 | 31 | No | 1



# ПОЛЬЗОВАТЕЛЬСКИЙ ИНТЕРФЕЙС

## Толщина образца

The screenshot displays the Xenometrix XRS-PP software interface. At the top, there is a menu bar (File, Acquire, Setup, Calibrate, Process, Help) and a control panel for the acquisition process, including fields for kV (40), uA (10), Preset (120), Time (120.0), and X, Y, Z coordinates.

The main area is divided into several sections:

- Specimen Component Table:** A table listing components with columns for #, Component, Type, Conc, Error, Units, Mole%, and Error. The table shows components like Al2O3, CaO, Fe, MgO, Pb, and Zn.
- Thickness Information:** A highlighted table showing layer details. The table has columns for Layer (Thick, Type, Error, Units, Density, Fixed) and Normalize (OK, Total). The data row shows a thickness of 0.000, Type Bulk, Error 0.000, Units mg/cm2, Density 0.000, Fixed unchecked, OK checked, and Total 100.00.
- Global Threshold Settings:** A section with a dropdown for 'n-sigma' set to 2.000, a 'Clear' button, and a 'Conc Method' checkbox.
- Element Table:** A table with columns for #, Element, Cond, Measurement (Intensity, Error, Backsc, Conc, Error, MDL, Atorn%), Threshold (Value, Conc), Intensity (Method), Ratio (Method), PSD (keV) (Low, High, Fil), Quant (Method), and Calibration (TCC Coef). It lists elements Br, Ca, Fe, Zn, and Pb.
- Measurement & Processing Conditions:** A section with radio buttons for 'Measurement' and 'Processing'. Below it is a table with columns for Code, X-Ray Source (Target, Filter, Thick(um), kV, uA), Detector (Type, Filter, Thick(um), Atmos), Chamber (Preset, Actual), and Monitor (Intensity). The data row shows Target Rh, Filter None, Thick 0.00, kV 40.0, uA 10.0, Detector Si(DD), Filter None, Thick 0.00, Atmos Vac, Preset 120.0, Actual 120.0, and Monitor 0.0.

At the bottom, there is a status bar showing the file path 'D:\PPS\IRFP\_MANUAL\0\_sfp.thr' and a progress indicator '0 | Off | Off | 2040 | 20 | 31 | No | 1'.

# ПОЛЬЗОВАТЕЛЬСКИЙ ИНТЕРФЕЙС

The screenshot displays the Xenometrix XRS-PP software interface. At the top, there are menu options: File, Acquire, Setup, Calibrate, Process, and Help. Below the menu is the 'Acquire' section with various parameters like HV, I, Preset, Time, and X, Y, Z coordinates.

The main area is divided into several sections:

- Specimen Component Table:** A table listing components like Al2O3, CaO, Fe, MgO, Pb, and Zn with their respective concentrations and errors.
- Thickness Information:** A table showing layer thickness, type, error, units, density, and total thickness.
- Global Threshold Settings:** A section for setting analysis thresholds.
- Element Table:** A detailed table showing measurement data for elements Si, Ca, Fe, Zn, and Pb. This table is highlighted with a black border in the image. It includes columns for Element, Cond, Measurement (Intensity, Error, Backgr., Conc., Error, MDL, Atom%), Threshold, Intensity, Ratio, ROI (keV), CH2, Quant, and Calibration.
- Measurement & Processing Conditions:** A table detailing the experimental setup, including X-Ray Source (Target, Filta, Thick), Detector, Chamber, Time, and Monitor.

At the bottom, there is a status bar showing the current file path and various system indicators.

Элементы образца и их аналитические линии.  
Выбор метода оценки интенсивности

# ПОЛЬЗОВАТЕЛЬСКИЙ ИНТЕРФЕЙС

The screenshot displays the Xenometrix XRS-FP software interface. At the top, there is a menu bar (File, Acquire, Setup, Calibrate, Process, Help) and a control panel for acquisition parameters including kV (40.0), uA (10.0), Preset (120), and Time (120.0). Below this, the 'Specimen Component Table' lists elements like Al2O3, CaO, Fe, MgO, Pb, and Zn with their respective concentrations and errors. To the right, 'Thickness Information' shows a table for Layer Normalization with columns for Thick, Type, Error, Units, Density, Fixed, OK, and Total. Below that, 'Global Threshold Settings' are set to n-sigma 2.000. The 'Element Table' is shown in 'Normal' mode, listing elements Si, Ca, Fe, and Zn with their measurement parameters and thresholds. At the bottom, the 'Measurement & Processing Conditions' section is highlighted with a green box, showing a table with columns for X-Ray Source (Target, Filter, Thick), Detector (Type, Filter, Thick), Chamber (Atmos), Time (Preset, Actual), and Monitor (Intensity). The status bar at the very bottom indicates the current status and counts.

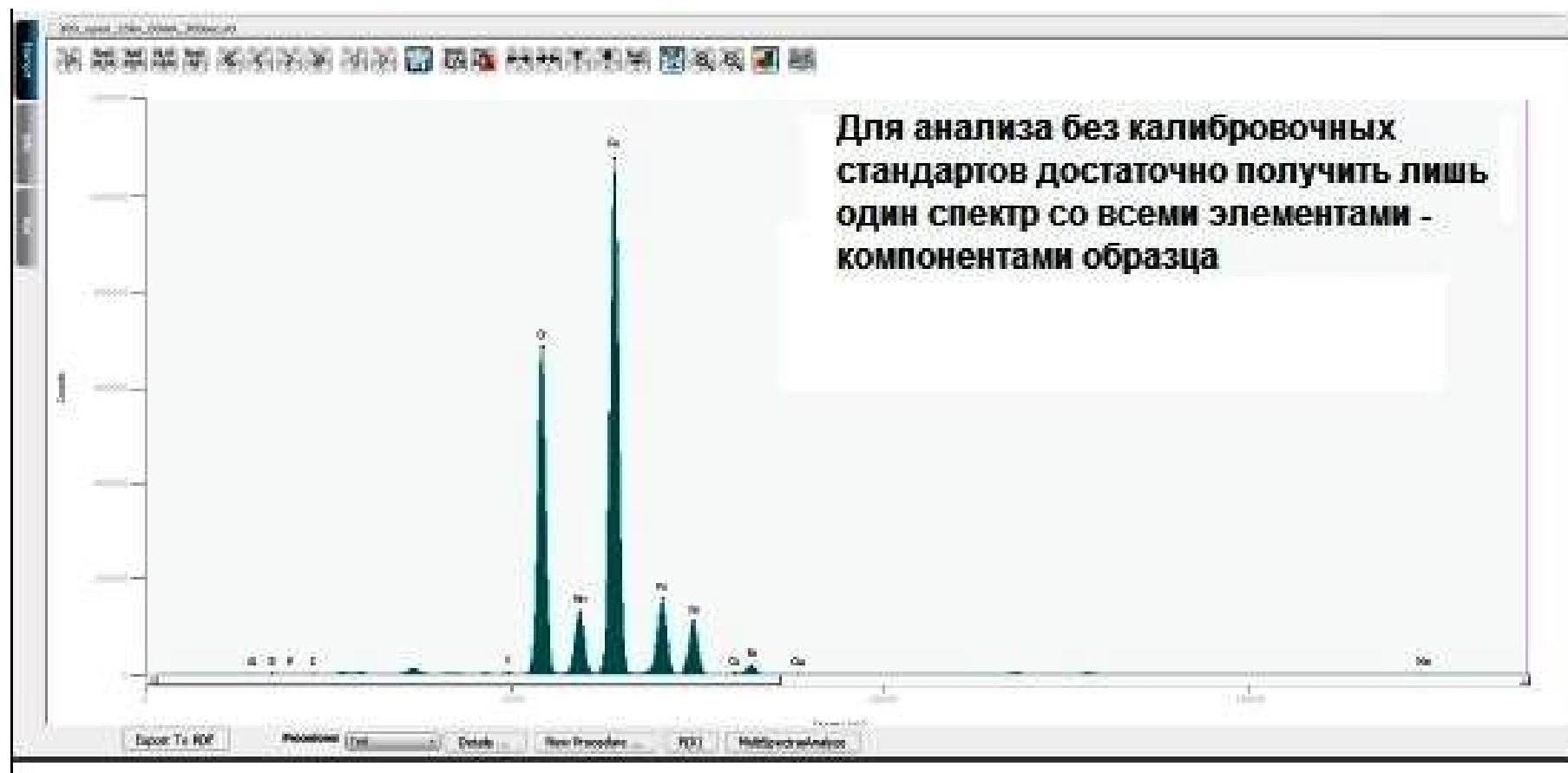
Условия сбора и обработки спектральных данных

# РАБОТА БЕЗ СТАНДАРТОВ – СХЕМА ДЕЙСТВИЙ

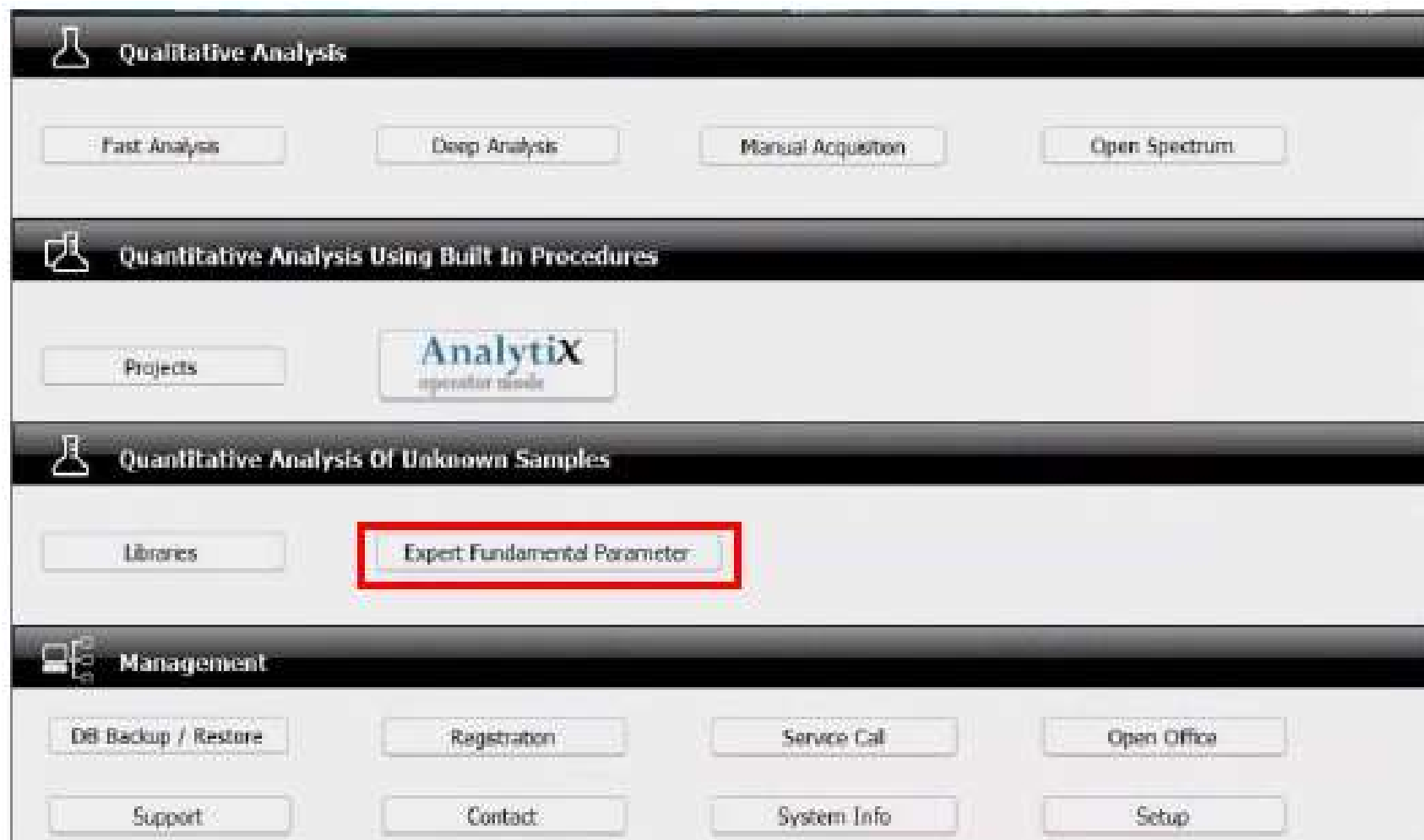


Получить спектр в программном пакете Analytix  
(файл с расширением .str)

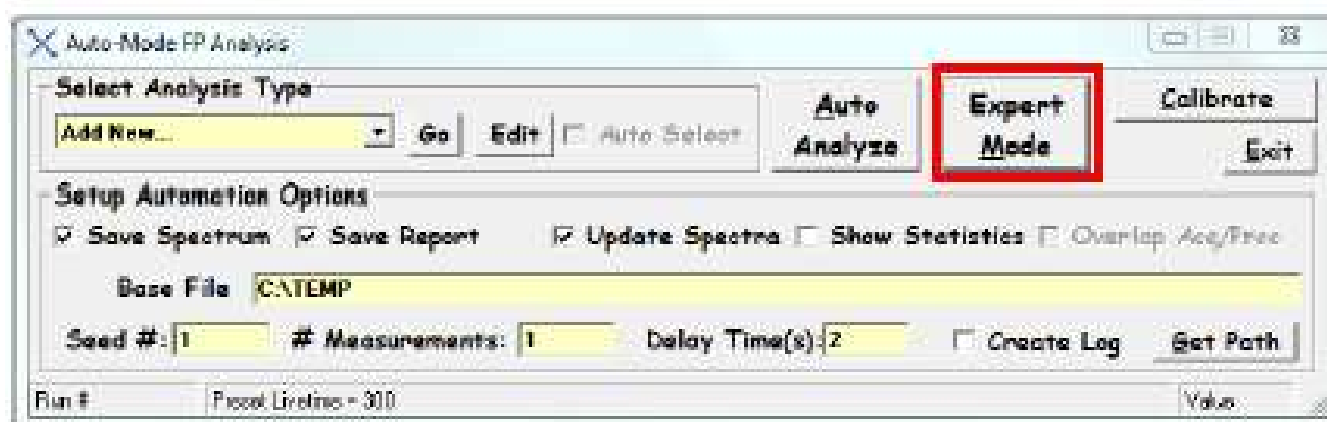
# ПОЛУЧЕНИЕ СПЕКТРА



# КАК ЗАПУСТИТЬ XRS-FP?

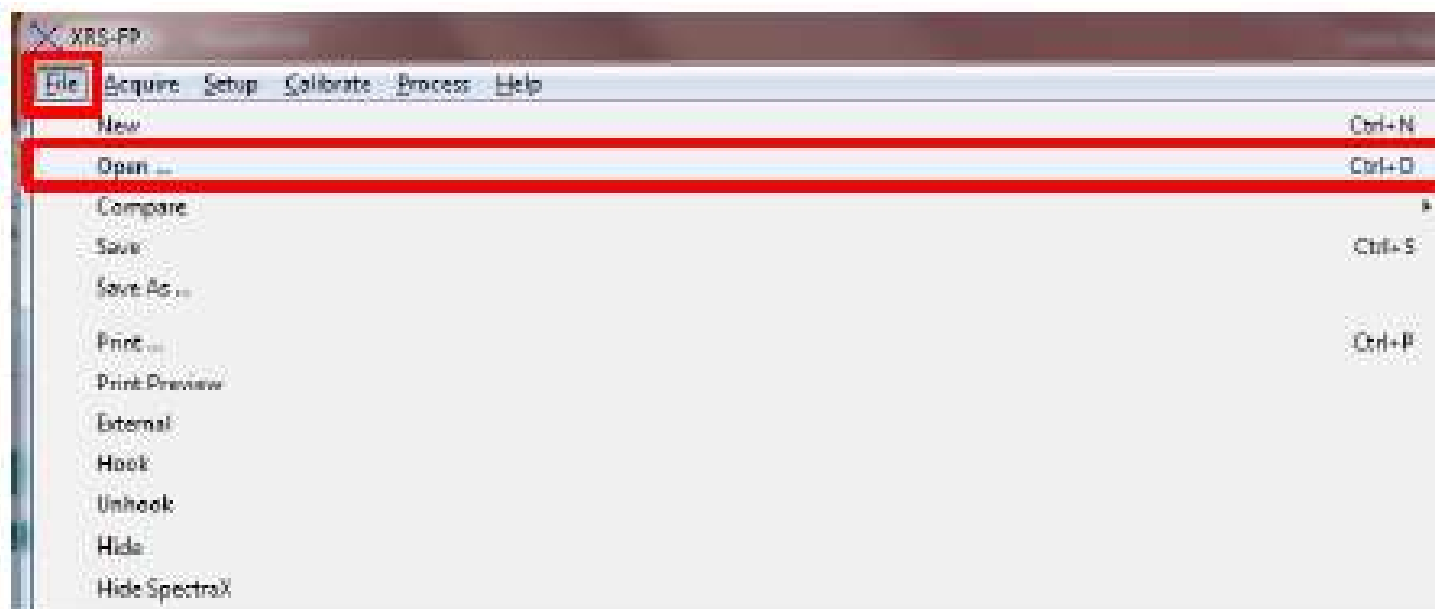


# КАК ЗАПУСТИТЬ XRS-FP?

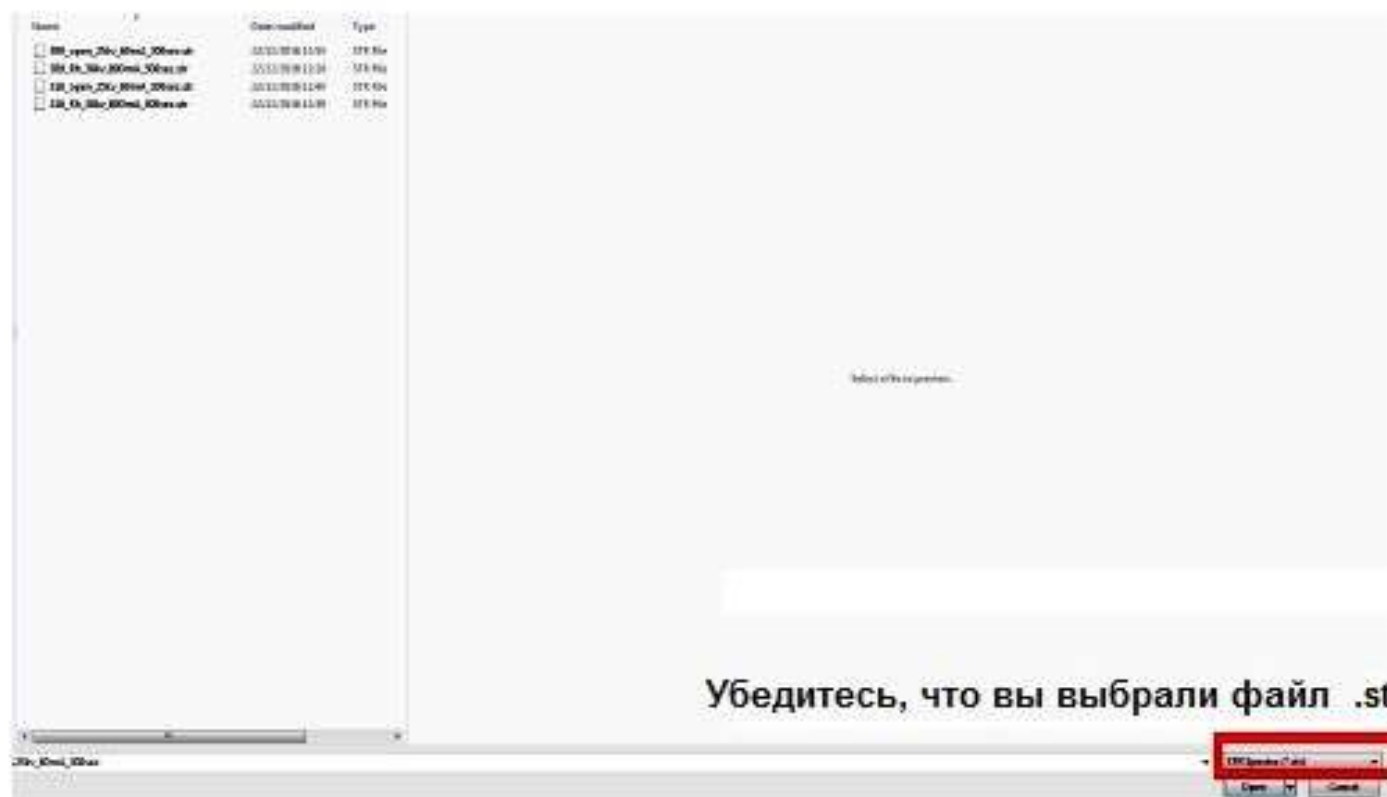




# ОТКРЫТЬ СПЕКТР




# ОТКРЫТЬ СПЕКТР



# УСЛОВИЯ ИЗМЕРЕНИЙ

Как только спектр открыт, следует зайти в окно “Measurement” (Измерение) и установить следующие параметры: фильтр, атмосфера, время

Measurement & Processing Conditions:												
<input checked="" type="radio"/> Measurement <input type="radio"/> Processing												
Code	X-Ray Source					Detector			Chamber	Time (secs)		Monitor
	Target	Filter	mg/cm <sup>2</sup>	kV	uA	Type	Filter	mg/cm <sup>2</sup>	Atmos	Preset	Actual	Intensity
1	Alk	None	0.000	25.0	60.0	Si drift	None	0.000	Air	300.0	300.000	0.0



## ТАБЛИЦА КОМПОНЕНТОВ

Введите все идентифицированные компоненты

Specimen Component Table:

#	Component	Type	Conc.	Error	Units	Mole%	Error
3	Ni	Calc	0.0000	0.0000	wt.%	0.0000	0.0000
4	Mn	Calc	0.0000	0.0000	wt.%	0.0000	0.0000
5	Cu	Calc	0.0000	0.0000	wt.%	0.0000	0.0000
6	Mo	Calc	0.0000	0.0000	wt.%	0.0000	0.0000
7	Co	Calc	0.0000	0.0000	wt.%	0.0000	0.0000
8	Si	Fixed	1.0000	0.0000	wt.%	0.0000	0.0000

Для следовых элементов - 1%

Больше данных – лучше точность

Element Table:  Normal  Coefficients n-signa 200 Libs Load Method

#	Element		Conc	Measurement							Threshold	Intensity	Ratio	ROI (keV)		Ch2	Quant	Calibration
	Elem	Line		Code	Intensity	Error	Backgr	Conc.	Error	MDL				Atom%	Value			
2	Cr	Ka	1	0.00	0.000	0.000	0.00000	0.00000	0.00000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	FP	0.00
3	Mn	Ka	1	0.00	0.000	0.000	0.00000	0.00000	0.00000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	FP	0.00
4	Fe	Ka	1	0.00	0.000	0.000	0.00000	0.00000	0.00000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	FP	0.00
5	Co	Ka	1	0.00	0.000	0.000	0.00000	0.00000	0.00000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	FP	0.00
6	Ni	Ka	1	0.00	0.000	0.000	0.00000	0.00000	0.00000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	FP	0.00
7	Cu	Ka	1	0.00	0.000	0.000	0.00000	0.00000	0.00000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	FP	0.00

Выберите линию: K, L или M

# ВЫБОР МЕТОДА ОЦЕНКИ ИНТЕНСИВНОСТИ

The screenshot shows the XRS-PP software interface. The 'Process' menu is open, and the 'Spectrum' option is selected. Within the 'Spectrum' submenu, the 'All' option is highlighted. The interface includes several data tables and control panels.

**Specimen Component Table:**

#	Component	Type
2	Ni	Calc
4	Mn	Calc
5	Ca	Calc
6	Mo	Calc
7	Co	Calc
8	Si	Fixed

**Element Table:** Normal

#	Element	Zone	Intensity	Error	Backgr.	Conc.
4	Fe	Ka	1	0.00	0.000	0.0000
5	Ca	Ka	1	0.00	0.000	0.0000
6	Ni	Ka	1	0.00	0.000	0.0000
7	Co	Ka	1	0.00	0.000	0.0000
8	Mo	Ka	1	0.00	0.000	0.0000

**Measurement & Processing Conditions:** Measure

Code	X-Ray Source				Detector		Chamber	Time (secs)		Monitor	
	Target	Filter	mg/cm <sup>2</sup>	kV	uA	Type	Filter	mg/cm <sup>2</sup>	Preset	Actual	Intensity
1	Fe	None	0.000	25.0	60.0	Si det	None	0.000	300.0	300000	0.0

**Process Menu Options:** Calculate, AutoID, Spectrum, Analyze, Simulate, Batch, Compress, Expand, Efficiency Correct, Smooth, Escape Peaks, Peak Removal, Background Removal, Blank Subtraction, Compton Peak, Deconvolute, All, Restore, Update Spectrum.

**Layer Information Table:**

Layer	Type	Error	Units	Density	Fixed	DF	Total
0.000	Bulk	0.000	mg/cm <sup>2</sup>	0.000		100	100.00

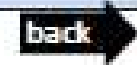
**Threshold Settings:** 2.000, Conc Method

**Intensity, Ratio, ROI (keV), Ch2, Quant, Calibration Table:**

Intensity	Ratio	ROI (keV)	Ch2	Quant	Calibration	
Method	Method	Low	High	Fit	Method	TCC Coeff
Gaussian	None	0.000	0.000	0.000	FP	0.00
Gaussian	None	0.000	0.000	0.000	FP	0.00
Gaussian	None	0.000	0.000	0.000	FP	0.00
Gaussian	None	0.000	0.000	0.000	FP	0.00

**Status:** Updated Element Table Concentrations. 0 | 00 | 00 | 2048 | 20 | 75 | No | 1

Process -> Spectrum -> All



# АНАЛИЗ

The screenshot shows the XRS-FP software interface. The 'Process' menu is open, and 'Analyze' is highlighted. The 'Specimen Component Table' lists elements Ni, Mn, Cu, Mo, Co, and Si. The 'Thickness Information' table shows a single layer with a thickness of 0.000 and a density of 0.000. The 'Global Threshold Settings' are set to 2.000 n-sigma. The 'Element Table' shows the results of the analysis for Fe, Co, Ni, Cu, and Mo. The 'Measurement & Processing Conditions' table shows the measurement parameters used.

**Specimen Component Table:**

#	Component	Type	Mole%	Error
3	Ni	Calc	0.0000	0.0000
4	Mn	Calc	0.0000	0.0000
5	Cu	Calc	0.0000	0.0000
6	Mo	Calc	0.0000	0.0000
7	Co	Calc	0.0000	0.0000
8	Si	Fixed	1.0000	0.0000

**Thickness Information:**

Layer					Normalize		
Thick.	Type	Error	Units	Density	Fixed	OK	Total
0.000	Bulk	0.000	mg/cm2	0.000	<input type="checkbox"/>	<input checked="" type="checkbox"/>	100.00

**Global Threshold Settings:**

n-sigma: 2.000 Clear Conc Method

**Element Table:**  Normal  Coefficients

#	Element	Line	Code	Conc	Measurement					Threshold		Intensity	Relat	ROI (keV)	Ch2	Quant	Calibration			
					Intensity	Error	Backgr	Conc	Error	MDL	Atom%	Value	Conc	Method	Method	Low	High	Fit	Method	TEC Coef
4	Fe	Ka	1	26416.60	28.472	118.753	0.00000	0.00000	0.00000	0.000	0.000	0.000	<input type="checkbox"/>	Gaussian	None	6.307	6.488	0.741	FP	0.00
5	Co	Ka	1	298.95	10.217	94.950	0.00000	0.00000	0.00000	0.000	0.000	0.000	<input type="checkbox"/>	Gaussian	None	6.829	7.017	2.943	FP	0.00
6	Ni	Ka	1	2890.09	0.916	41.280	0.00000	0.00000	0.00000	0.000	0.000	0.000	<input type="checkbox"/>	Gaussian	None	7.371	7.569	0.057	FP	0.00
7	Cu	Ka	1	80.40	3.725	14.847	0.00000	0.00000	0.00000	0.000	0.000	0.000	<input type="checkbox"/>	Gaussian	None	7.936	8.140	0.021	FP	0.00
8	Mo	Ka	1	27.95	1.119	14.657	0.00000	0.00000	0.00000	0.000	0.000	0.000	<input type="checkbox"/>	Gaussian	None	17.243	17.611	0.016	FP	0.00

**Measurement & Processing Conditions:**  Measurement  Processing

Code	X-Ray Source					Detector			Chamber	Time (secs)		Monitor
	Target	Filter	mg/cm2	kV	uA	Type	Filter	mg/cm2	Atmos	Preset	Actual	Intensity
1	Fe	None	0.000	25.0	50.0	Si-drift	None	0.000	Air	300.0	300.000	0.0

Status: Spectrum Intensity Calculations Completed (0.97 secs.) | 0 | 0M | 0M | 2648 | 20 | 75 | No | 1

Logon: 500004-Edwards on 2011-04-15

Process -> Analyze

**ВАЖНО!**

- XRS-FP требует знания полного элементного состава образца
- Для следовых компонентов (<1000 ppm) точность будет низкой
- Измерение C, N, O в бесстандартном режиме невозможно

## ПРИМЕРЫ: МЕТАЛЛИЧЕСКАЯ СТРУЖКА

- Для проведения нестандартного анализа был получен образец металлической стружки, содержащей 13% Mn

Конфигурация прибора	X-Calibur, Rh-анод, трубка 50кВ 50Вт
Детектор	SDD
Атмосфера	Гелий
Режим возбуждения	Прямое и со вторичной мишенью
Время экспозиции	300 сек
Метод анализа	Метод ФП





# ПРИМЕР: МЕТАЛЛИЧЕСКАЯ СТРУЖКА

Концентрации элементов, предоставленные заказчиком

Element	Concentration±10% [wt.%]	Low limit (-10%)	High limit (+10%)
C	0.81	0.729	0.891
Si	0.58	0.522	0.638
Mn	18.1	11.79	14.41
P	0.054	0.0486	0.0594
S	0.026	0.0234	0.0286
Cr	1.98	1.737	2.129
Mo	0.11	0.099	0.121
Ni	1.13	1.017	1.243
Al	0.17	0.153	0.187
Fe	82.09	73.881	90.299

Результаты измерений с помощью МФП

Sample Table -----

Layer	Component	Type	Concn.	Error	Units	Mole%
1	C	Fixed	0.810	0.000	wt.%	3.623
1	Si	Calc	0.518	0.056	wt.%	0.991
1	Mn	Calc	12.985	0.043	wt.%	12.698
1	P	Calc	0.042	0.018	wt.%	0.073
1	S	Fixed	0.026	0.000	wt.%	0.044
1	Cr	Calc	1.949	0.014	wt.%	2.014
1	Mo	Calc	0.110	0.002	wt.%	0.062
1	Ni	Calc	1.172	0.041	wt.%	1.073
1	Al	Calc	0.164	0.015	wt.%	0.327
1	Fe	Calc	82.222	1.353	wt.%	79.096



# Xenometrix

*The Power to Change Energy Into Information*

**СПАСИБО ЗА ВНИМАНИЕ!**

Наши контакты в Казахстане:

По всем вопросам обращайтесь: **ТОО «Bio Engineering Group»**

г. Нур-Султан, Казахстан

e-mail: [info@bioegroup.kz](mailto:info@bioegroup.kz),

тел.: +7 7172 529 639

Контакт в Алматы: тел.: +7 777 234 6774

*Bio Engineering Group* 