OBUDA UNIVERSITY

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Institute of Technical Physics and Materials Science

Centre for Energy Research

‘ Non-Destructive Optical Mapping Tool From Cheap Parts ’

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OUTLINES

1. Introduction
    - 1.1. Aim of the Research
    - 1.2. Research Methods
    - 1.3.Characterization methods
2. Results of the Actual Semester
3. Plans For the Future Work

Research Topic

Non-Destructive Optical Mapping Tool From Cheap Parts

1. Introduction

Spectroscopic Ellipsometry (SE)

- Non-destructive, non-invasive and non-intrusive optical technique.
- Measures the relative change in polarization state of the measurement beam
- Amplitude ratio **ψ** and phase difference **Δ** between the **p**- and **s**-polarizations.

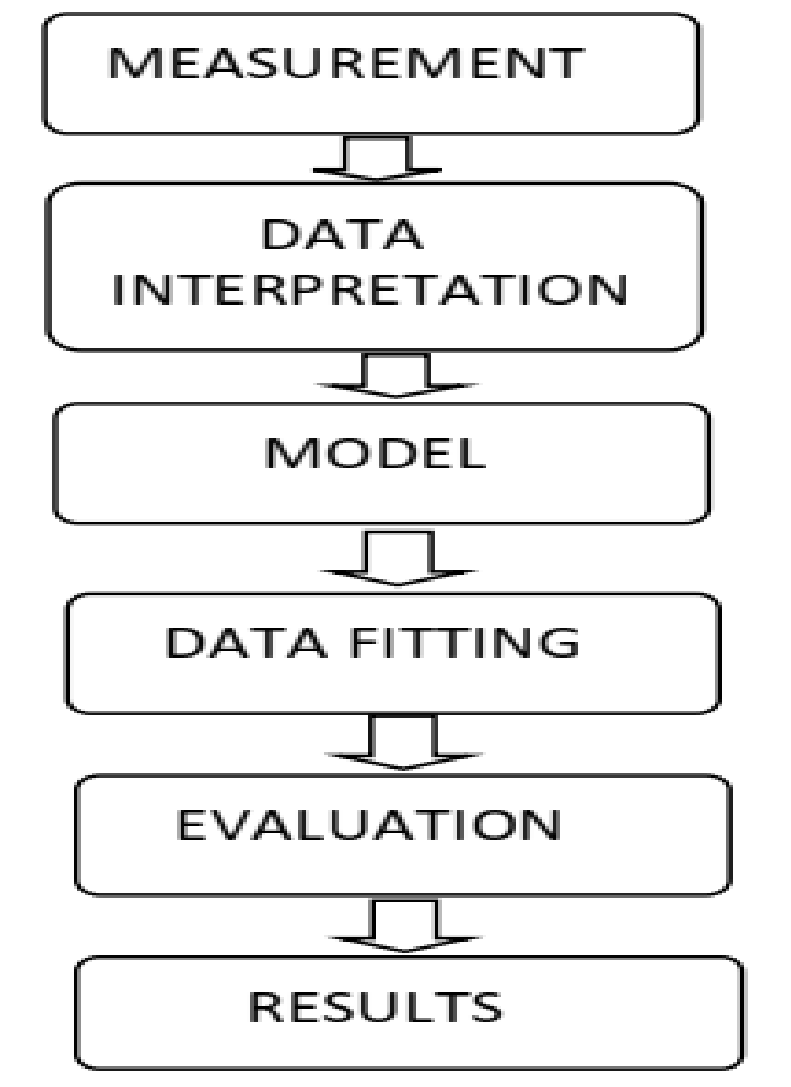


Figure 1: SE Technique Flow chart

1.1. Aim of the Research

- Making prototypes form cheap parts,

  like mobile phones, tablets, monitors and big screen LCD TV *
- Programming the data collection and data processing software
- Making measurements on selected samples and determining the precision of the prototype.

* The basis of the work a patent (from our Institute): Horváth Z Gy, Juhász G, Fried M, Major C, Petrik P: Imaging optical inspection device with a pinhole camera; EP2160591B1, Submission Number: PCT/HU2008/000058, NSZO: G01N21/8422 , Country of patent: Európa

1.2. Research Methods

Original Conceps of Prototype building using different parts

- 1. Light-source (LED-panel)
- 2. Diffuser sheet
- 3. film-polarizer
- 4. analyzer
- 5. detector (pin-hole+CCD-detector) and
- 6. sample

The new concept is without the polarizers

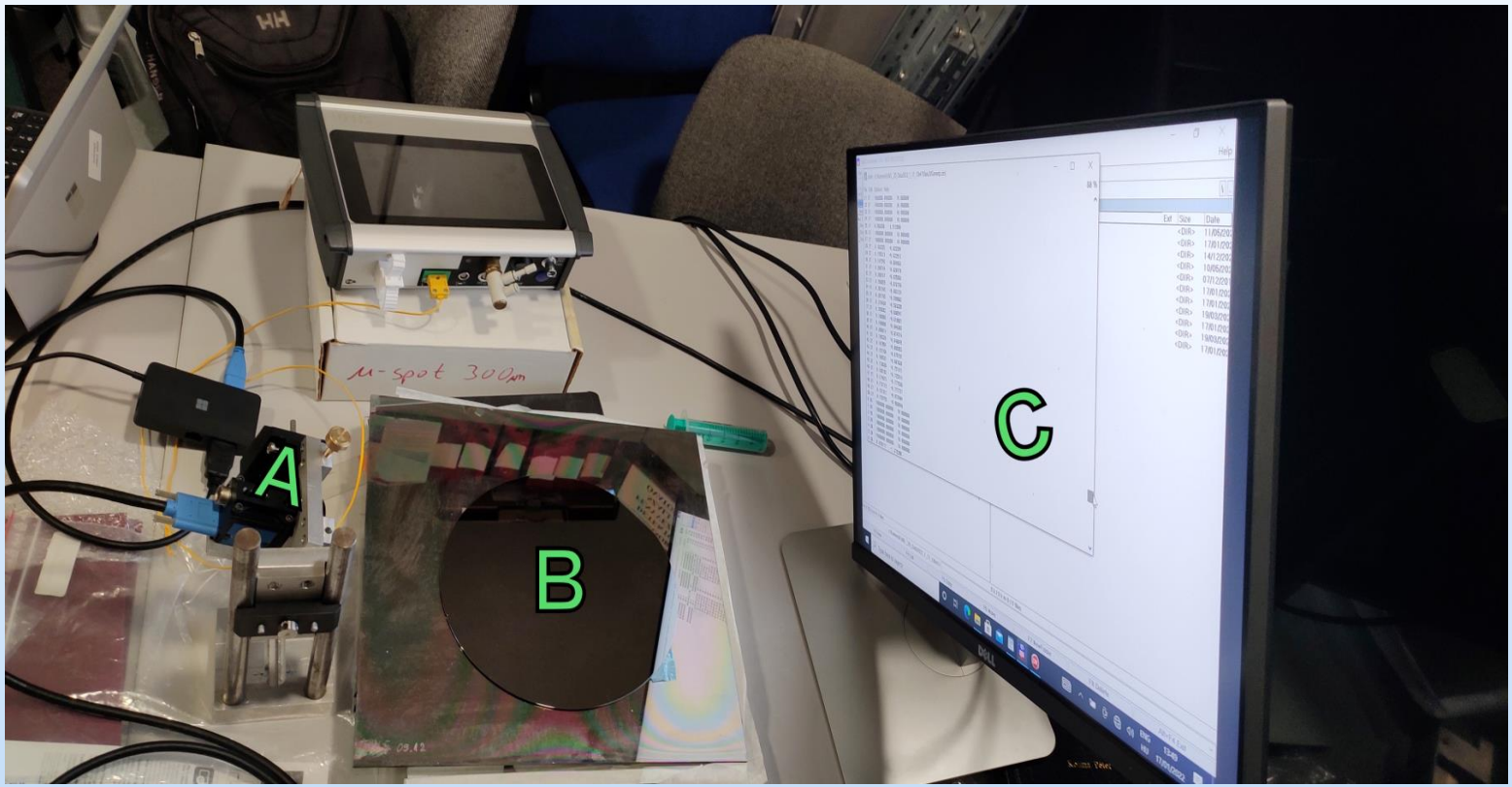
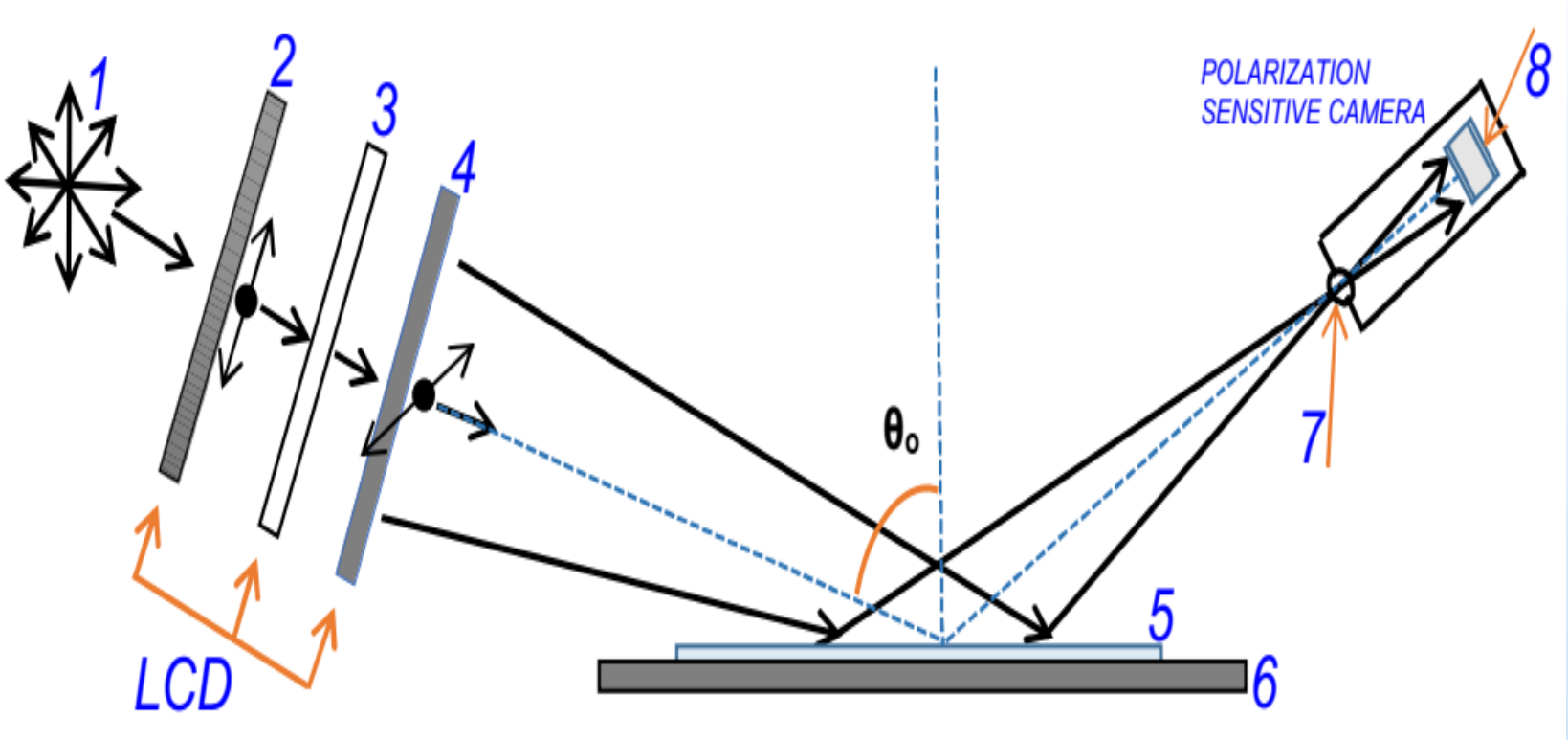


Figure 2: Experiment set up
A) Polarization sensitive camera **B)** Sample+Substrate and **C)** LCD monitor



- **Figure 3:** Original concepts of the non-collimated beam ellipsometer

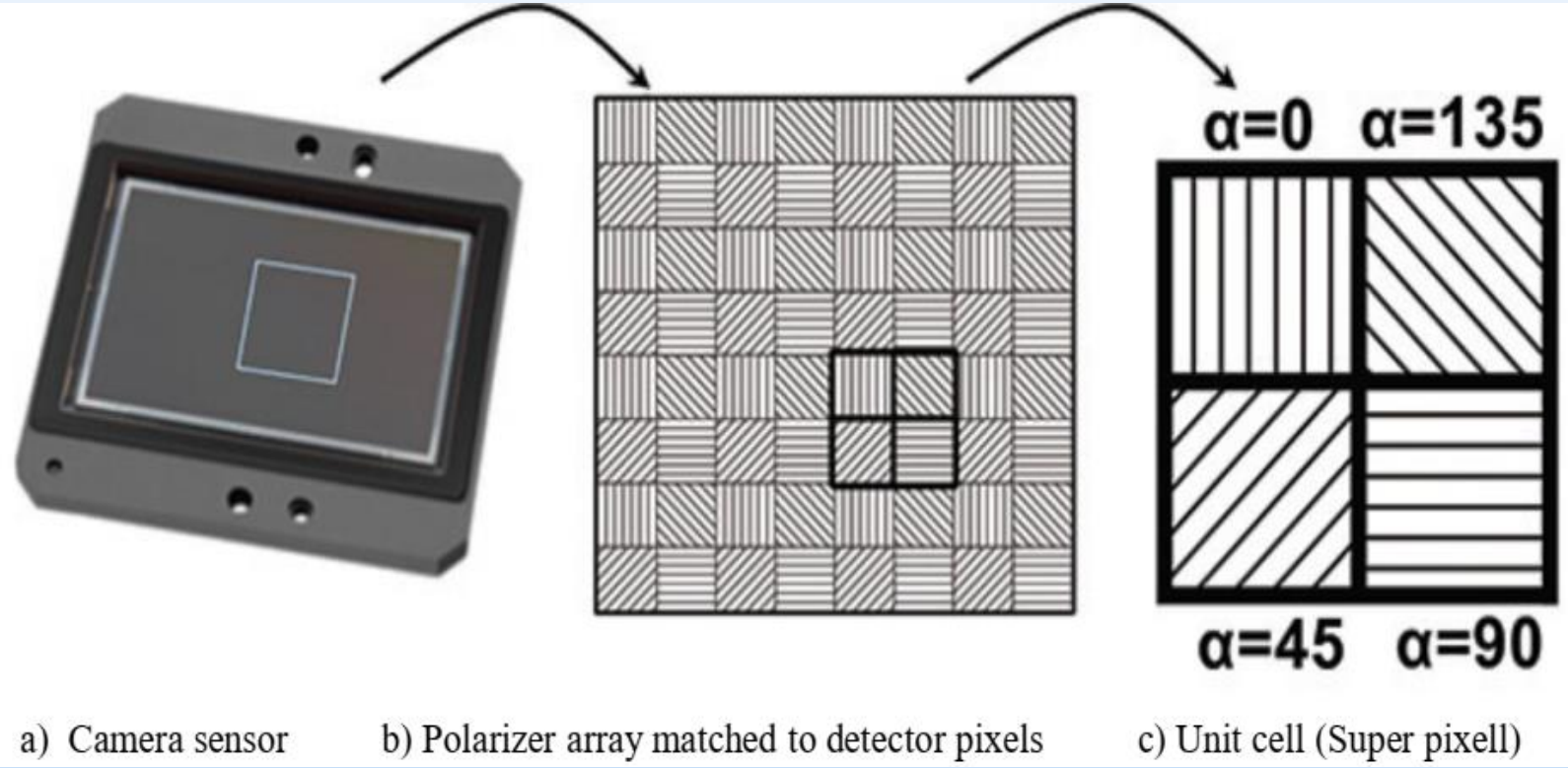
1) Light source **2)** Vertical polarizer **3)** Liquid crystal cell
4) Horizontal polarizer **5)** Sample **6)** Substrate
7) Pin hole and **8)** Camera sensor

- A big area LCD TV (or a monitor) serving polarized (built in polarizer sheet) RGB colored light (numbers 1-4 together) and a polarization sensitive camera behind a pinhole, as shown in fig.3 ,above.

- **Figure 4**: Polarization sensitive camera

- The polarization sensitive camera shown (fig. 4) serves for polarization state data ,

(fig. 5) from each position (plus 3 RGB colors in each position).



- **Figure. 5** : Schematic structure of a 2/3 inch Sony CMOS Pregius Polarsens sensor (IMX250MZR)

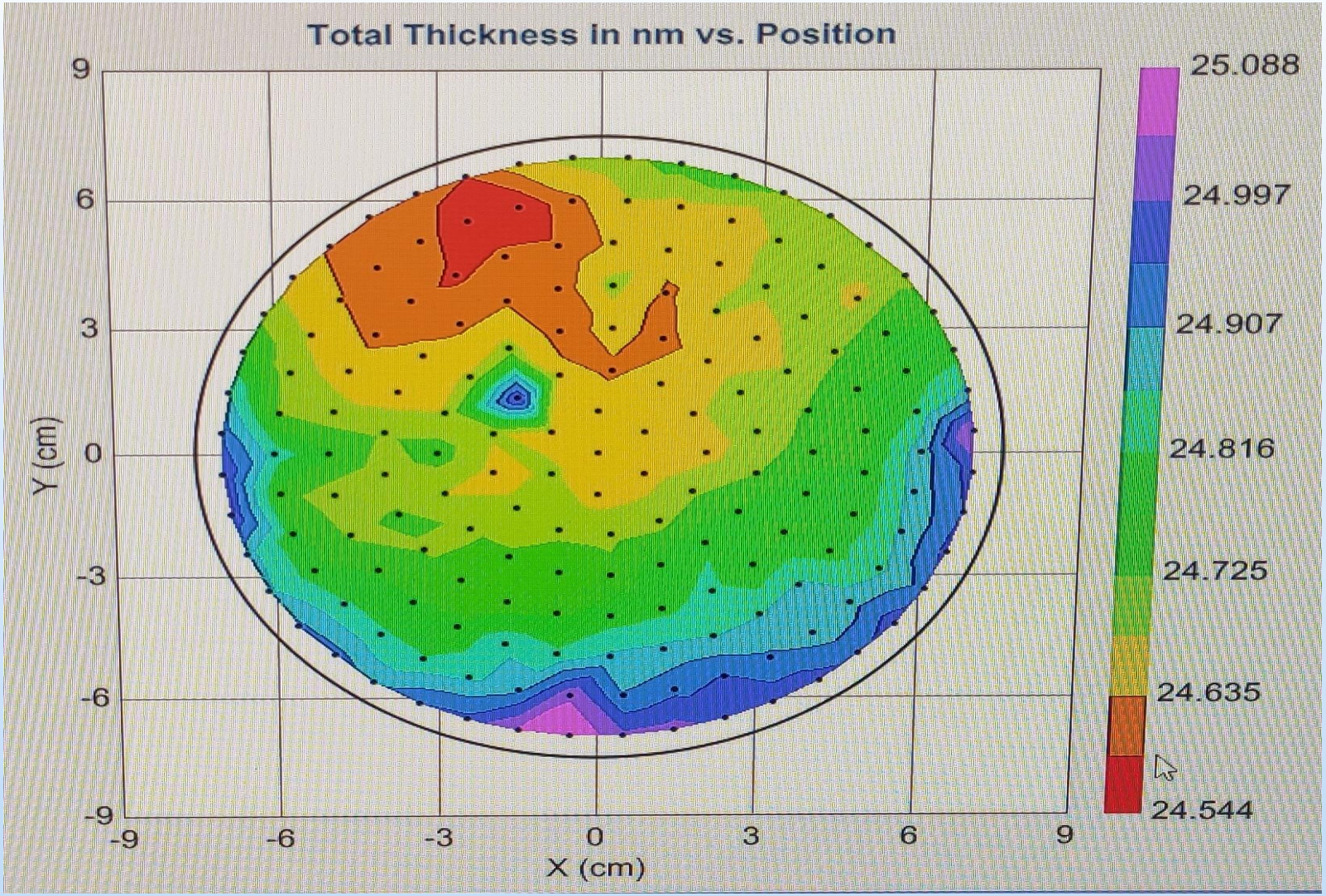
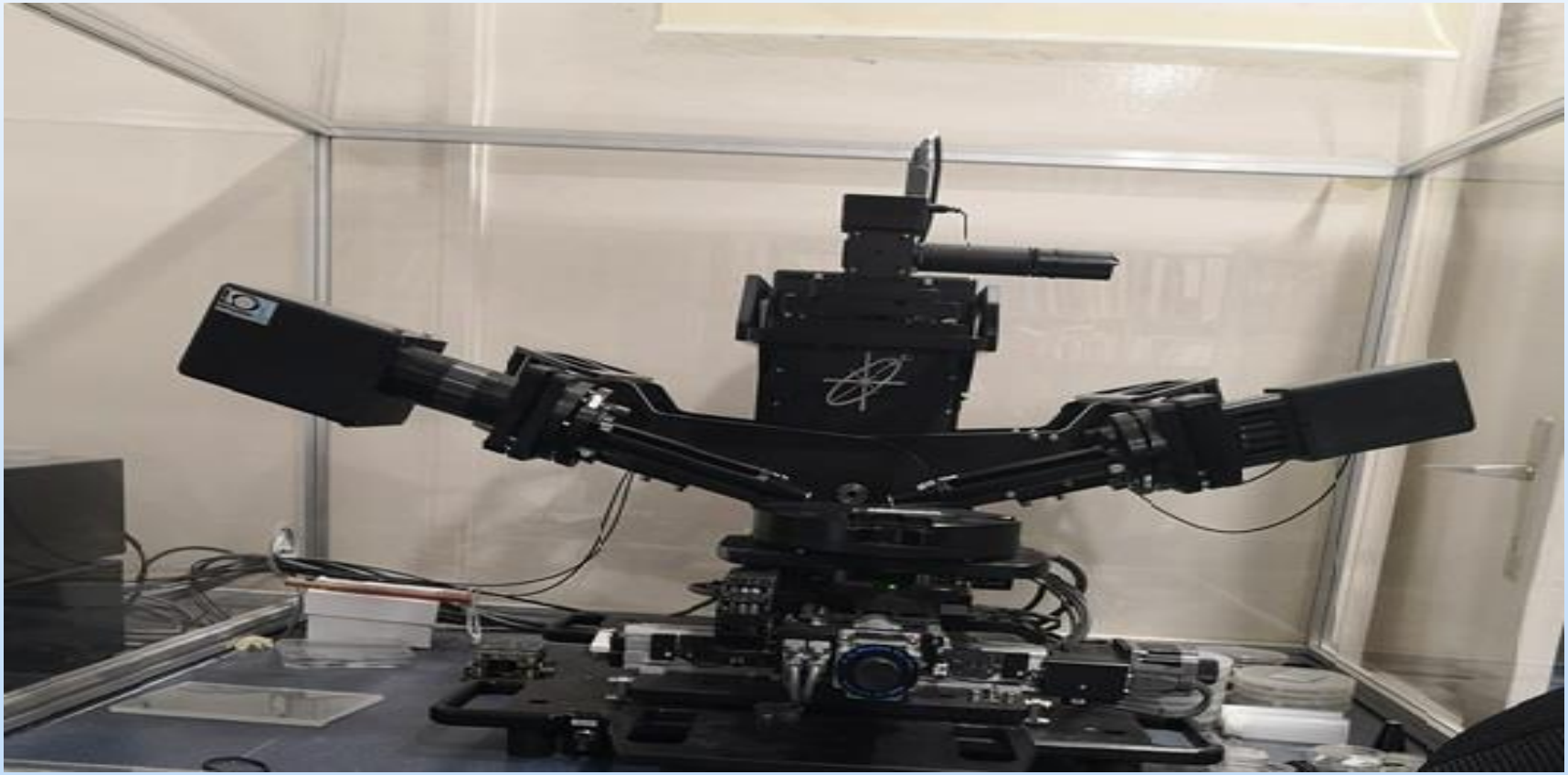


Figure 6: SiO_2 wafer thickness, measured from M2000DI ellipsometer for control measures

1.3.Characterization methods



- **Figure 7** :Rotating Compensator Spectroscopic Ellipsometer

Rotating Compensator Spectroscopic Ellipsometer

- Provides fast and very accurate thin film characterization over a wide spectroscopic range like,
- Measurement of film thickness and optical constants on single or multilayer stack.
- Mapping of film uniformity etc.
- Extreme sensitivity to very thin over layers below 1 nm thickness
- But it is Indirect analysis technique.

Rotating Compensator Spectroscopic Ellipsometer

Specifications

- Wavelength range of 191-1690 nm ,corresponding to photon energies of 0.7-6.5 eV
- Automatic scan over 15x15 cm area.
- Angle of incidence: 45-75 degree.
- Measurement time 1 sec per spot.

- Ellipsometry requires powerful software to get full benefit from the measurement. CompleteEASE™ (fig. 8)
- (in situ/ex situ) software packages provide easy calibration, data acquisition,and analysis for all of our applications

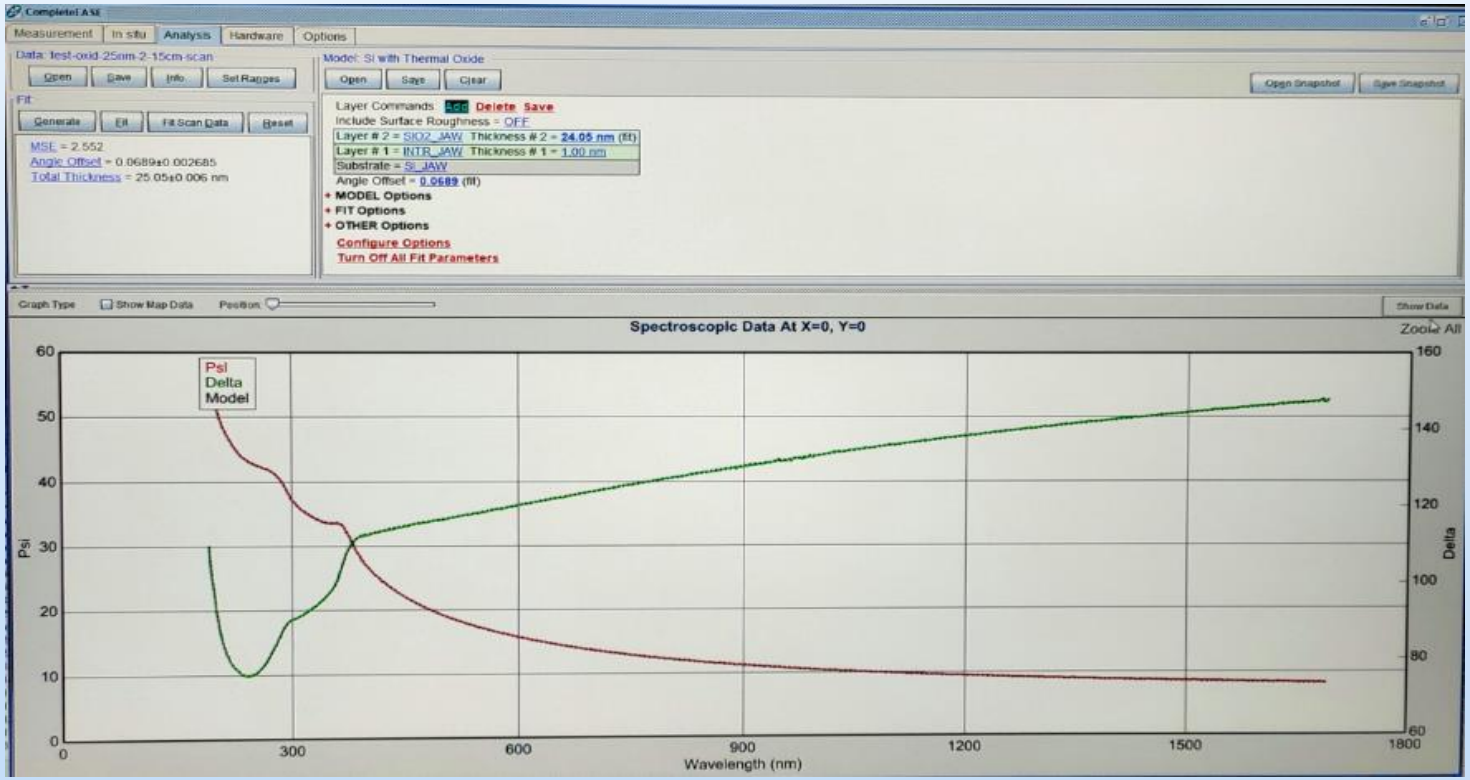
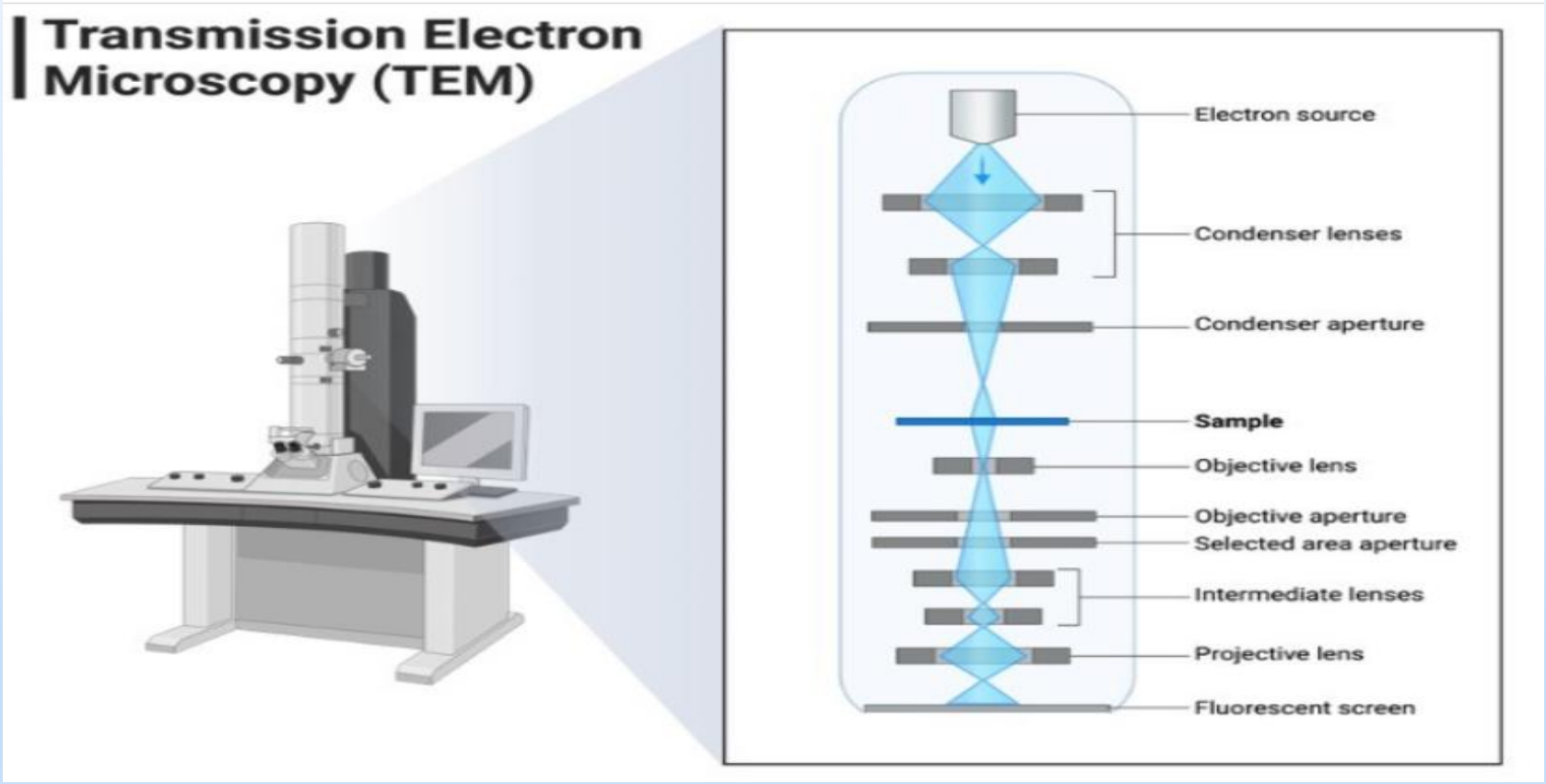


Figure 8: The data analysis parameters for Spectroscopic Ellipsometry device (CompleteEase software)

Transmission Electron Miscroscopy (TEM)



- **Figure 9:** TEM and its main parts

Transmission Electron Miscroscopy

Working Principle

- A beam of electrons passes through a thin specimen and gives information about inner structure of the sample,like crystal structure, morphology structural defects and impurity

Sample Preparation

- Ultra thin, elecron transparent,

  typically <100nm
- Nanocharacterization range (< 1 nm to 100 nm) to micrometer range and beyond.
- Direct measurement technique

2. Results of the Actual Semester

Course Nepton Code	Course Title	Instructor	Credit Points
OATKVTE1ND	Structural investigation of different materials by transmission electron microscopy	Dr. Katalin Balázsi	6
OAVROPM1ND	Optical Characterization of thin Layers	Dr. Péter Petrik	6
OATBESZ1ND	Research report I.		6
OATKUTP1ND	Research project I.		10
		Total Credit Points	**28**

3. Plans For the Future Work

- The first prototype will be built using the polarization sensitive camera and a monitor.
- 25-60 nm thick silicon-dioxide covered 200 mm diameter silicon wafers will be used for calibration.
- The M2000DI ellipsometer will be used for control measurements.
- Bigger samples will be made by a reactive DC magnetron sputtering system such as WO3-MoO3 mixed layers on glass

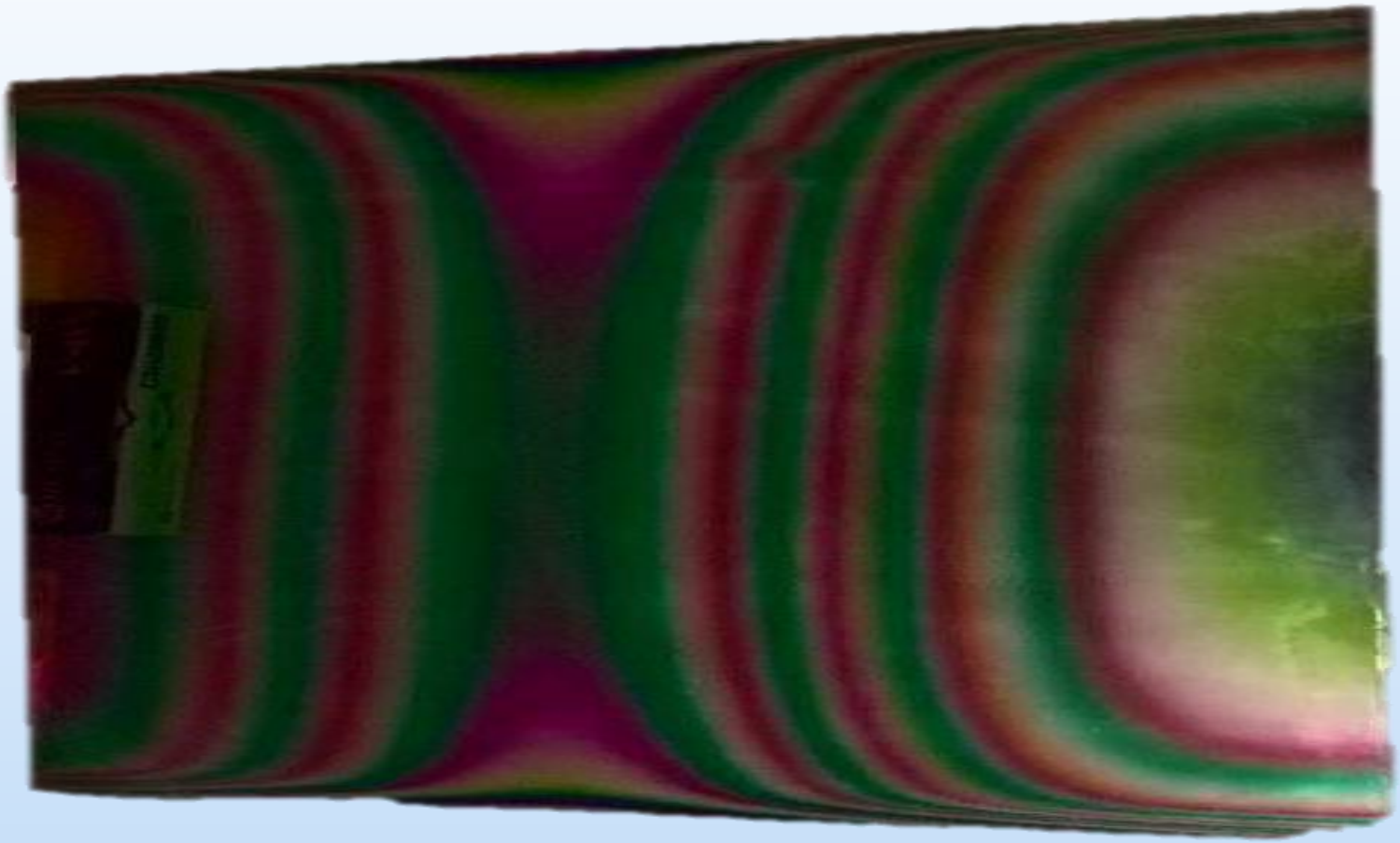


Fig 10: WO3-MoO3 combinatorial mixed layers on a 30x30 cm glass sheet. The colored bands show the changing thicknesses and compositions

köszönöm !