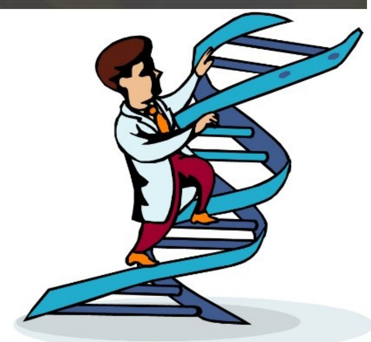
CHARACTERIZATION OF ZNO AS PIEZOELECTRIC FOR BIOSENSOR APPLICATIONS



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Background Study

Biosensor

- Biosensor was first develop by Professor Leland C Clark Jnr. in year 1962 based on his description about the electrochemical based sensors.
- Biosensor is a device that has been used to monitor living system and incorporating biotic elements such as DNA or microorganisms.
- ***Definition:*** Biosensor is an analytical device that consists of immobilized biological sensitive material that either in contact or integrated within the transducers which somehow can convert a biological signal into a measurable quantitative electrical signal.

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SAW BIOSENSOR

- Surface Acoustic Wave (SAW) based biosensor consists of two IDTs that are electrode pairs on the same side of a thin piezoelectric film. There is a space or delay line between the input and output IDTs.

- When a sinusoidal electrical voltage is applied to the input IDTs, oscillating mechanical strains in the piezoelectric thin film form travelling surface acoustic waves. The SAW is detected and converted back into a sinusoidal voltage of different phase and amplitude at the output IDTs.

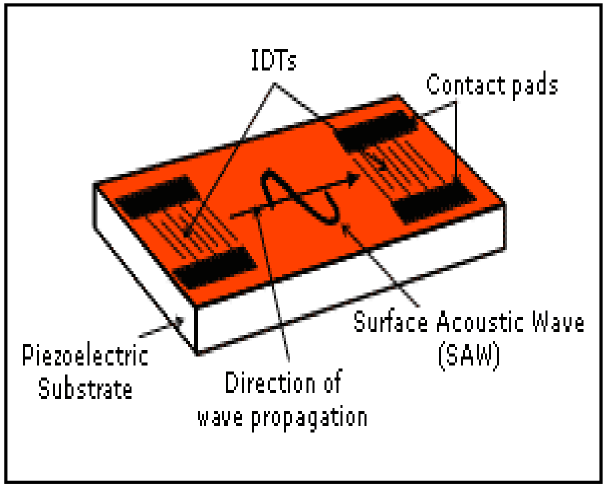

Figure of SAW based Biosensor

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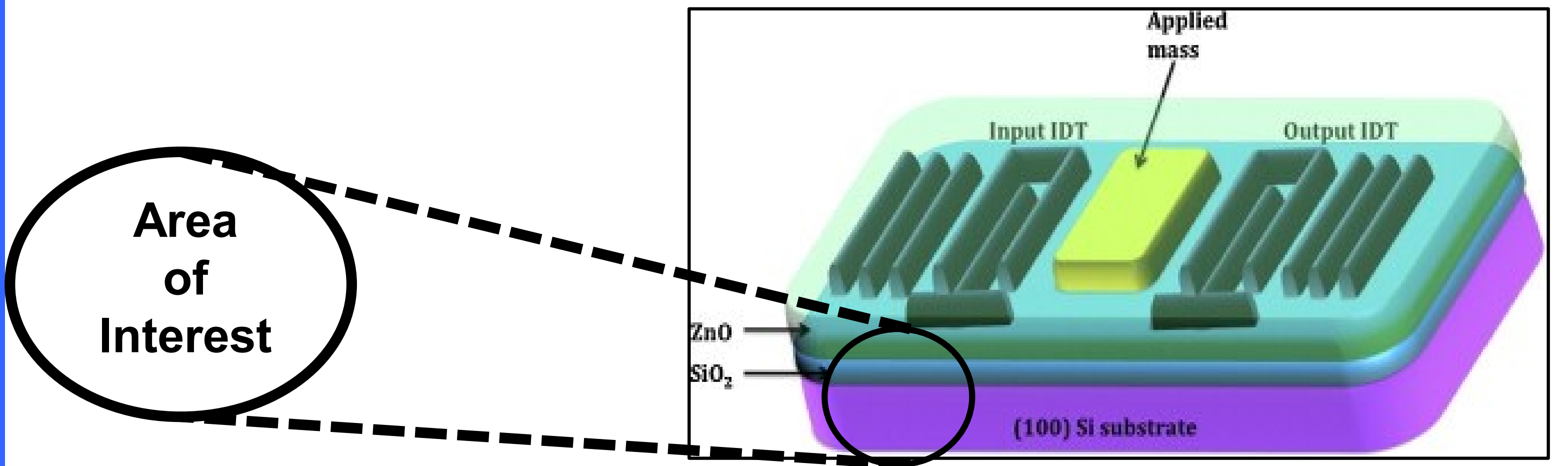
Focus Study

- The research focused on the preparation of ZnO thin film using standard fabrication process. The characterization were conducted to study the surface and optical characteristic of the thin films.



Example image of the ZnO thin film used as piezoelectric substrate.

Why ZnO??

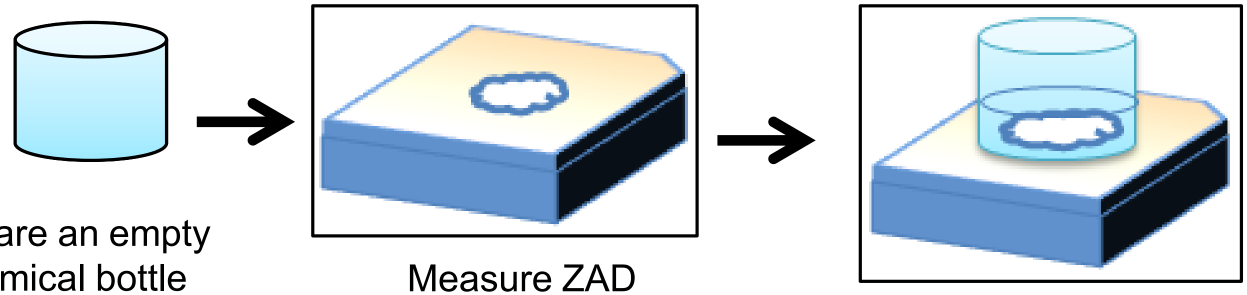
Advantages	Incentive
Cost availability	Widely used and low cost material.
Suitable for semiconductor applications	One of the unique features of ZnO is it has a very high level of transparency.
High level of transparency in visible and near infrared	An opportunity to replace ITO for future transparent electronic devices.
Suitability for contacts/electrodes	ZnO is reasonably good for patterning to improve the ability to serve as contacts/electrodes.
Availability in low temperature manufacturing approaches	Can lower the cost because ZnO can be created on plastic substrate.
ZnO as a Nanomaterial	ZnO is easily fabricated into many kinds of nanostructures.

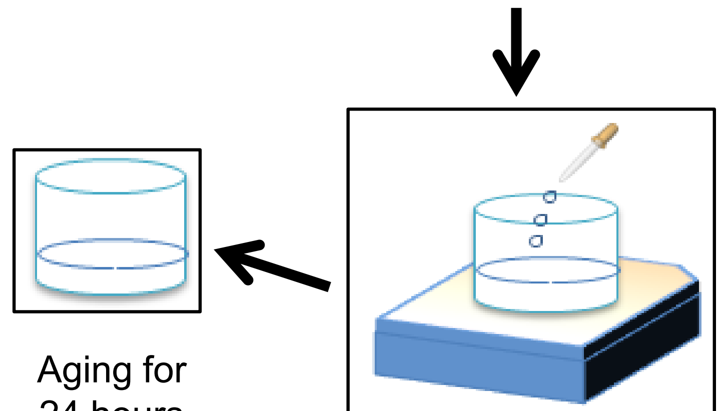
OBJECTIVE

- To prepare the ZnO thin films by using standard fabrication process.

- To characterize and study the important parameters involved that influence the performance and sensitivity.

METHODOLOGY





2-Methoxyethanol

Mass=MCV

Molar mass of ZAD	**219.5 g/Mol**
Molar mass of MEA	**61.08 g/mol**
Concentration (Molarity)	**0.2 mol/L**
Solvent Volume	**20 ml**

List of parameters to calculate the total mass

Figure of ZnO sol gel preparation process flow

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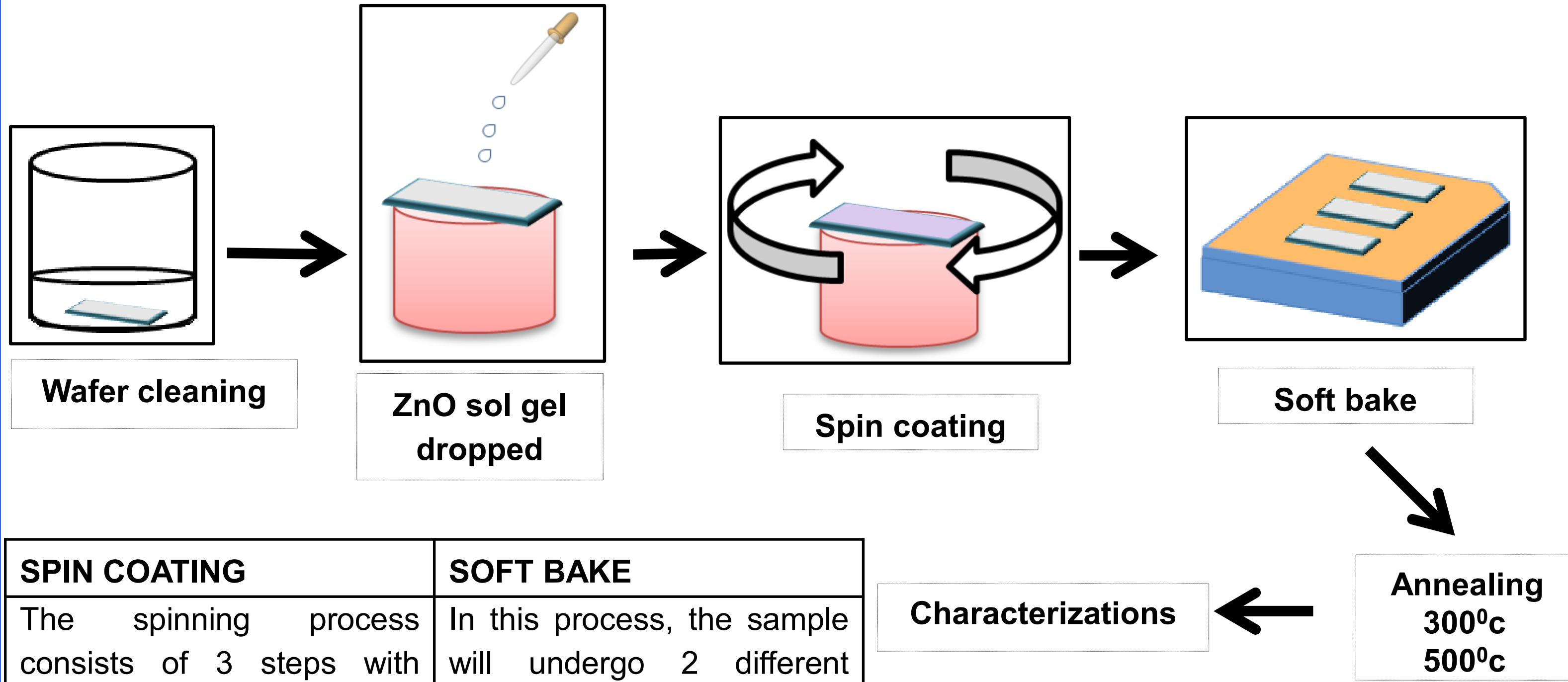


Figure of ZnO thin films deposition process flow

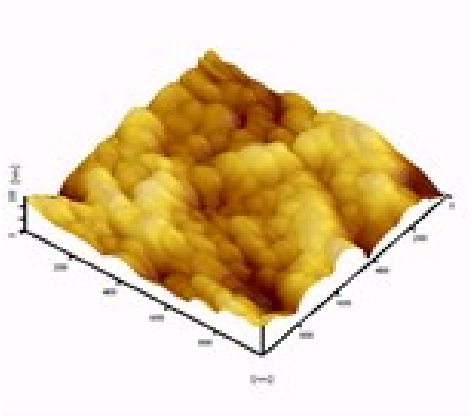
SPIN COATING	SOFT BAKE
The spinning process consists of 3 steps with different speeds for each step. • 1^{st} step – 800 rpm • 2^{nd} step – 3000 rpm • 3^{rd} step – 0 rpm	In this process, the sample will undergo 2 different temperature and time. • 60^0c – 20 minutes • 150^0c – 10 minutes • Remove the sample after the temperature was cool down to 50^0c

Table: List of parameters

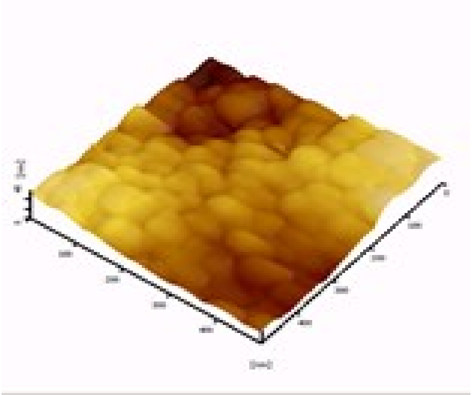
RESULTS AND DISCUSSION

AFM, from the observations:

- ❑ (a) shows the island surface structure.
- ❑ (b) shows the homogenous surface structure.



(a) Annealed at 300^0C



(a) Annealed at 500^0C

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- Shows good agreement with previous study with approximately ~4 nm of RMS value.
- The higher the annealing temperature, the greater the roughness of the thin films.

Solvent	Annealing Temperature (^0C)	Mean Diameter of Grain Size (nm)	Root Mean Square (RMS) (nm)	Average Roughness, R_a (nm)
2-Methoxyethanol	300	5.07	1.701	1.314
2-Methoxyethanol	500	5.97	4.539	3.579

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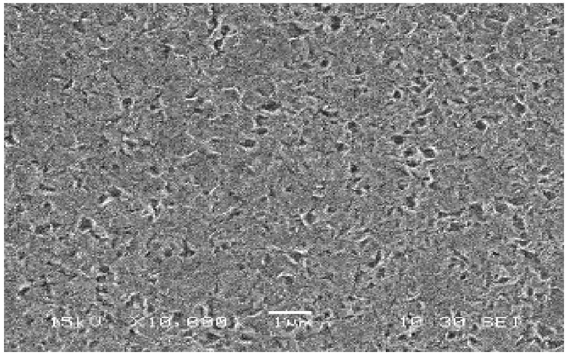
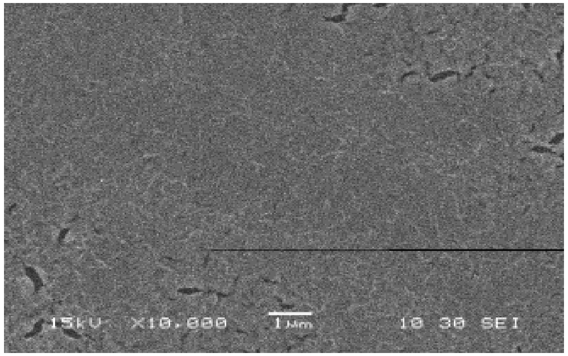
SEM, from the observations:

- (a) exhibiting the kind of fiber stripe particle.
- (b) provides great flatness of surface structure.



(a) Annealed at 300^{0}C



(a) Annealed at 500^{0}C

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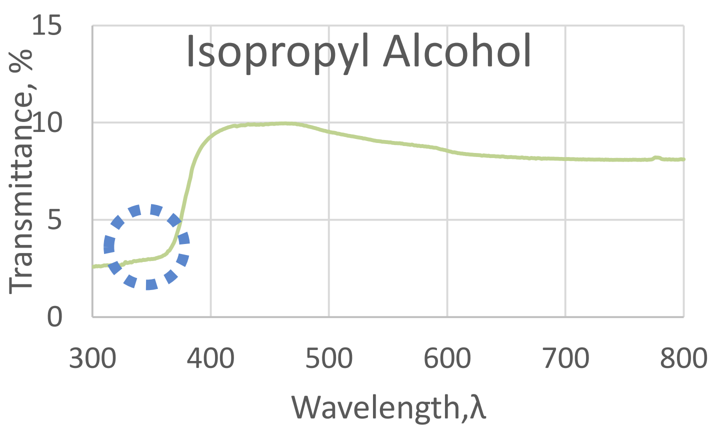
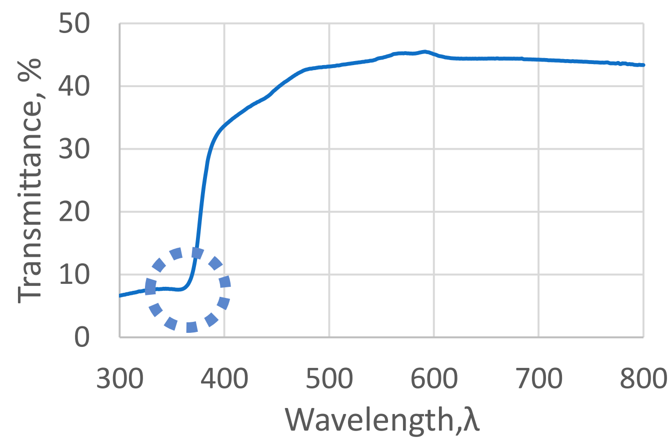
Optical Transmittance

- (a) potential cutoff wavelength take place from 370nm – 385nm.



(a) Annealed at 300^0C



(a) Annealed at 500^0C

CONCLUSION

Most of the parameters has been studied thoroughly

The results comes with reasonable explanations and important knowledges.

Thank You

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