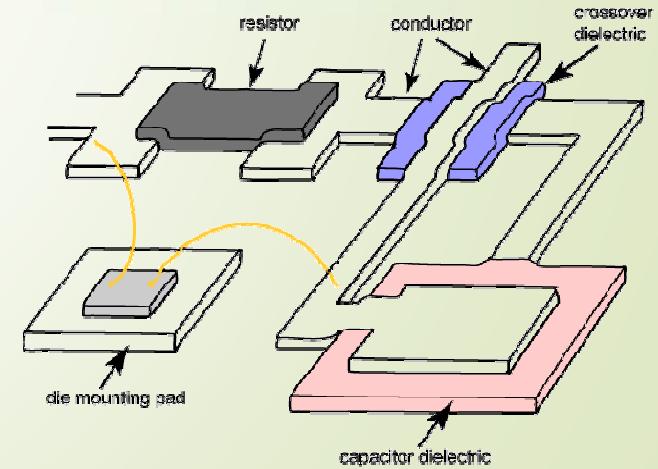


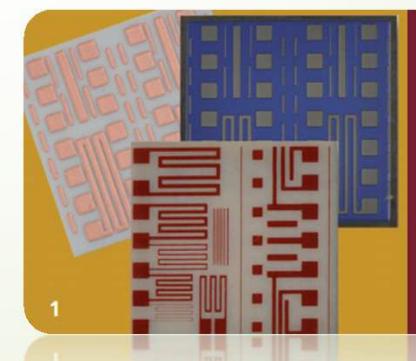
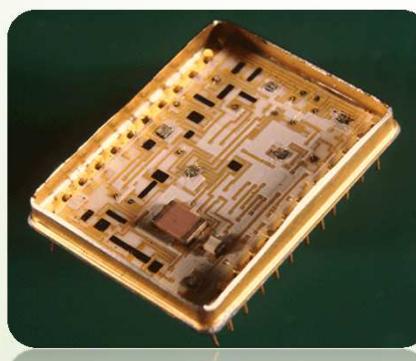
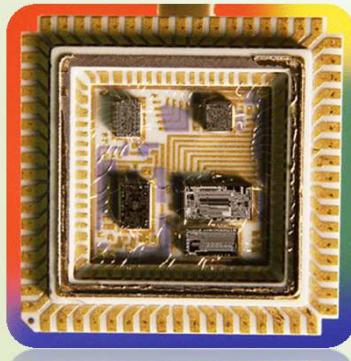
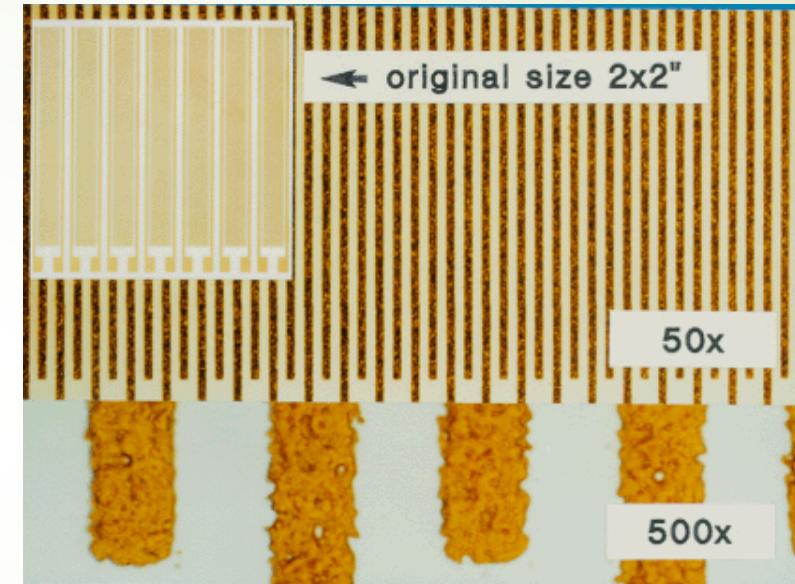
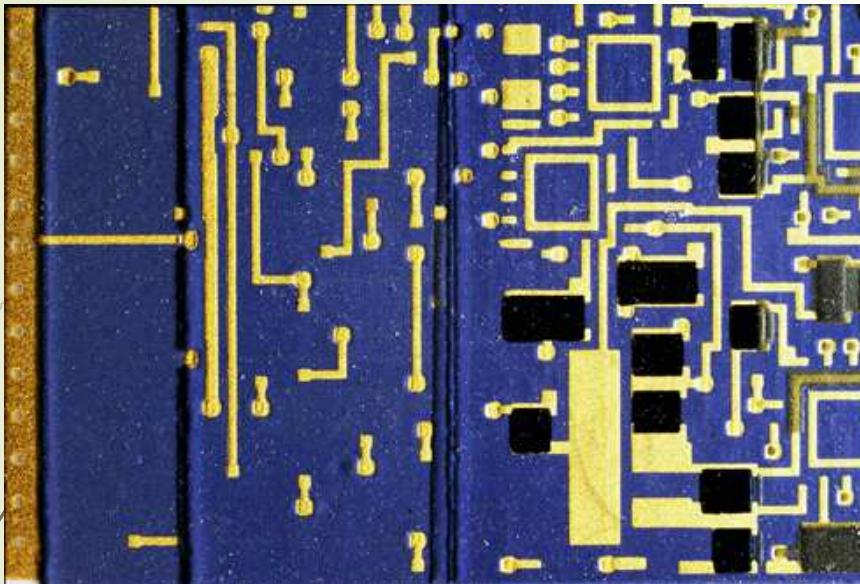
TEKNOLOGI FILM TEBAL MIKROELEKTRONIKA

Eka Maulana, ST, MT, MEng.

Teknik Elektro
Universitas Brawijaya

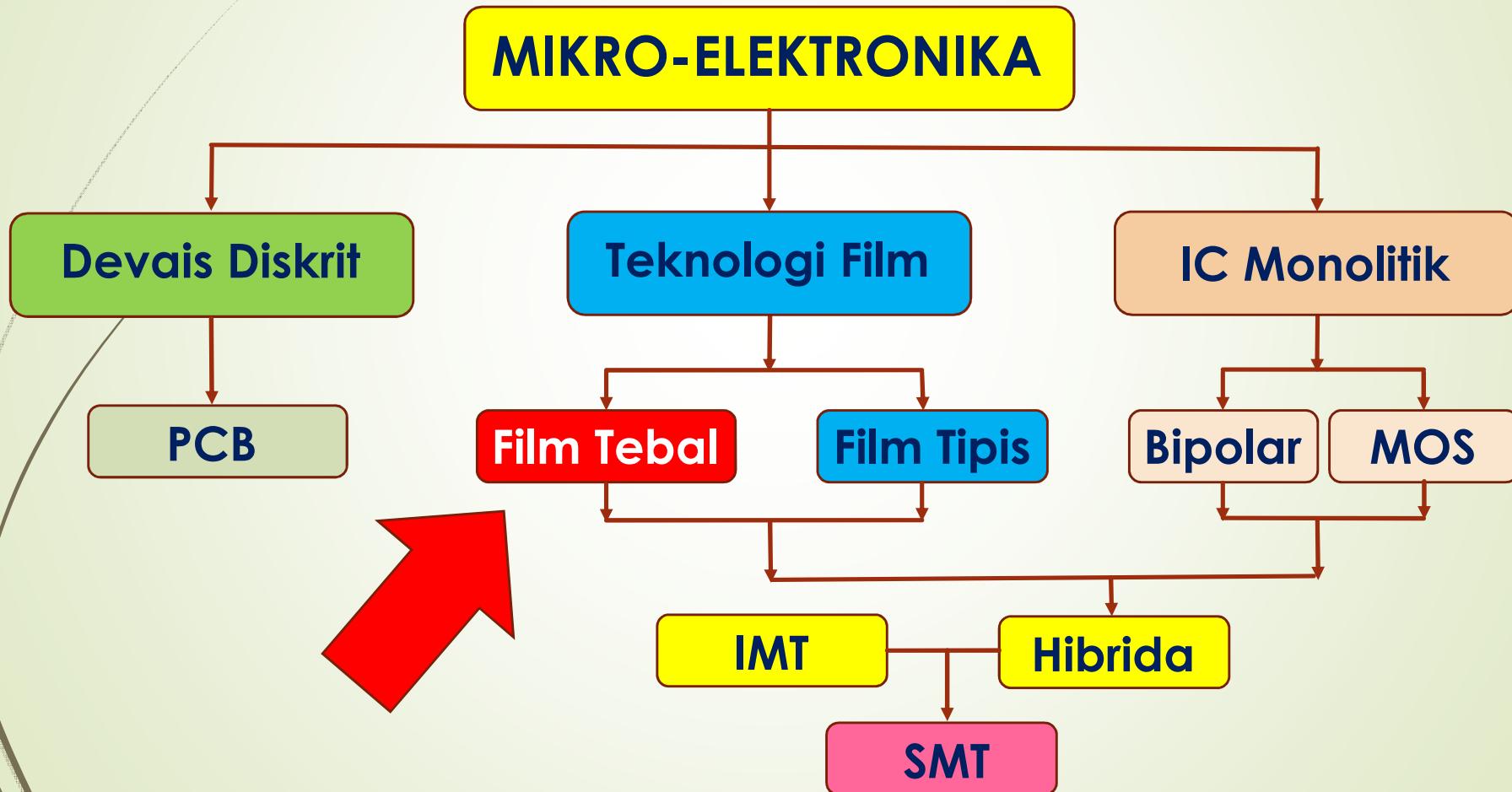


Pengantar: Perkembangan Teknologi



<http://www.ami.ac.uk>

KLASIFIKASI TEKNOLOGI MIKROELEKTRONIKA

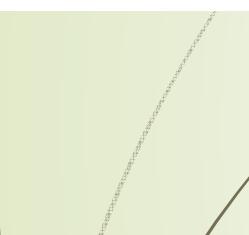


Klasifikasi Proses Film Tebal dan Film Tipis

Metal powder resin
composite screen printed

Thickness: **um**

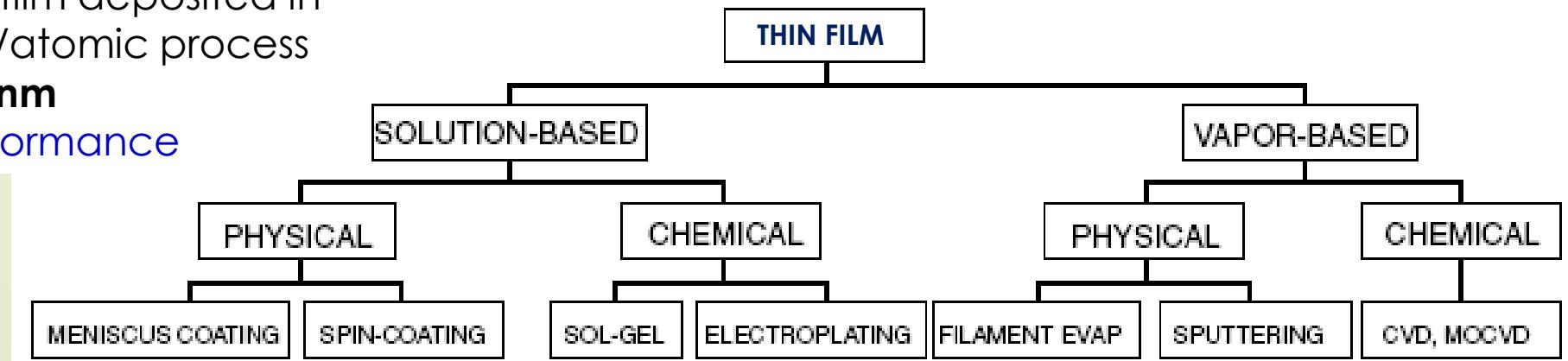
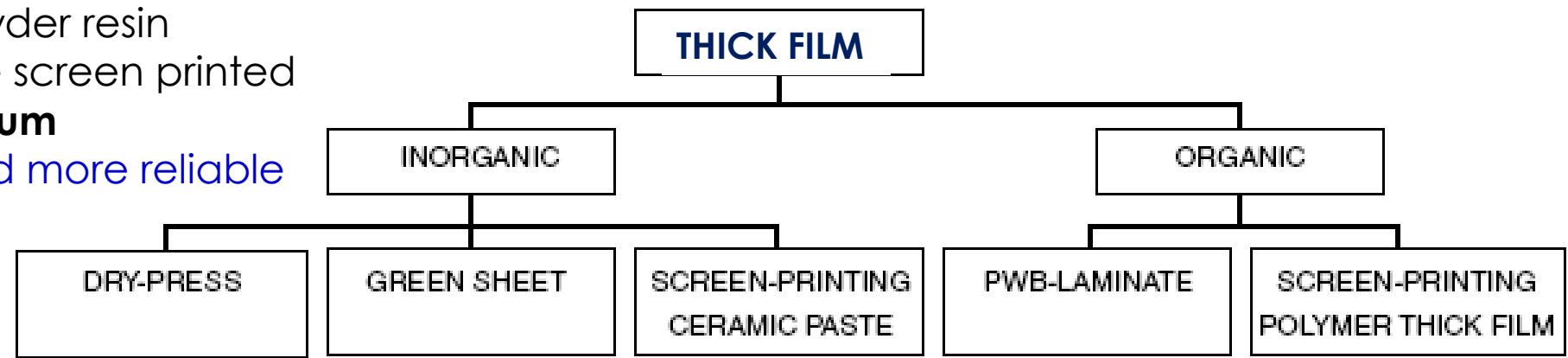
considered more reliable



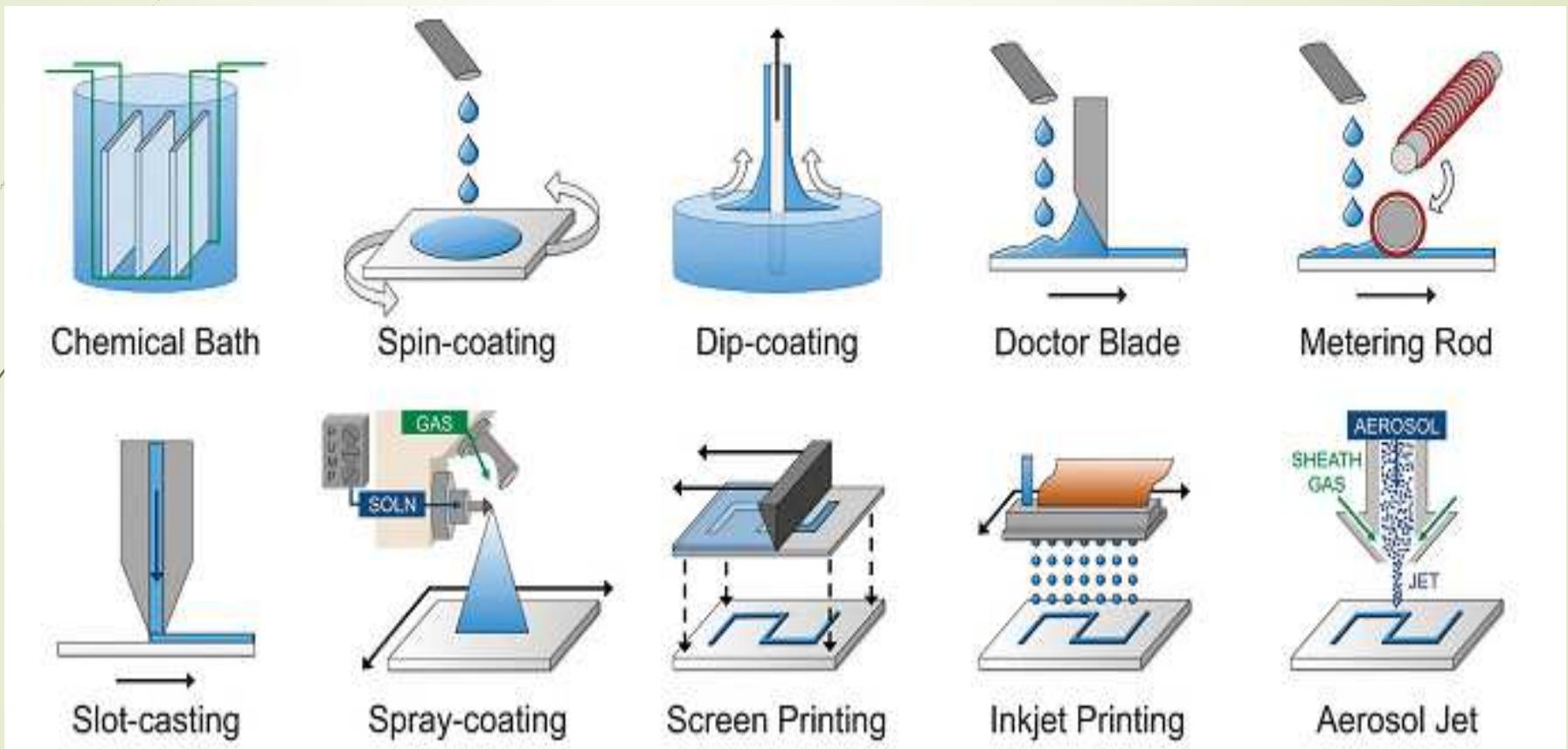
Metal thin film deposited in
molecular/atomic process

Thickness: **nm**

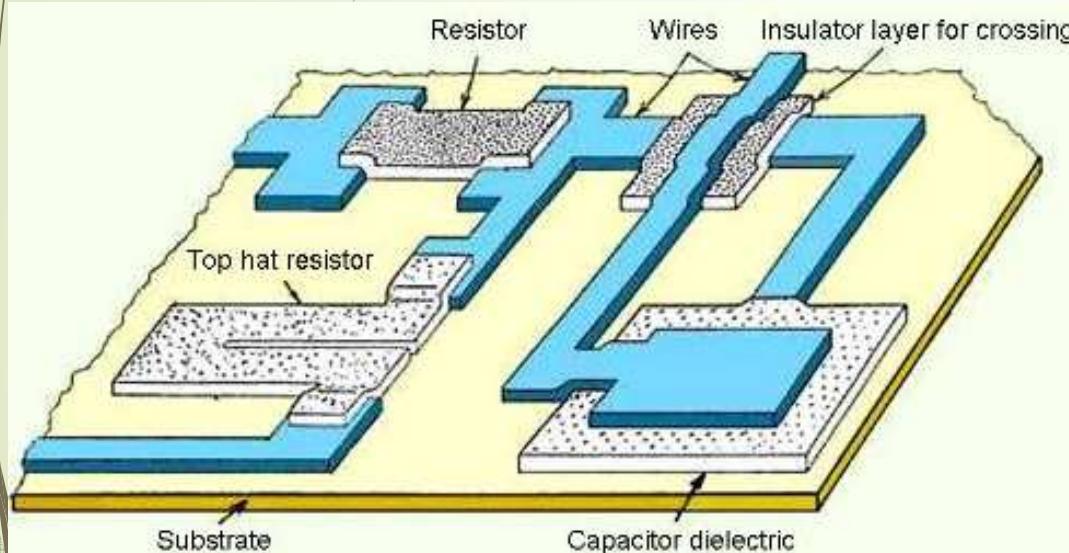
Better performance



Metode Deposi – Teknologi Film



Gambaran Teknologi Film Tebal

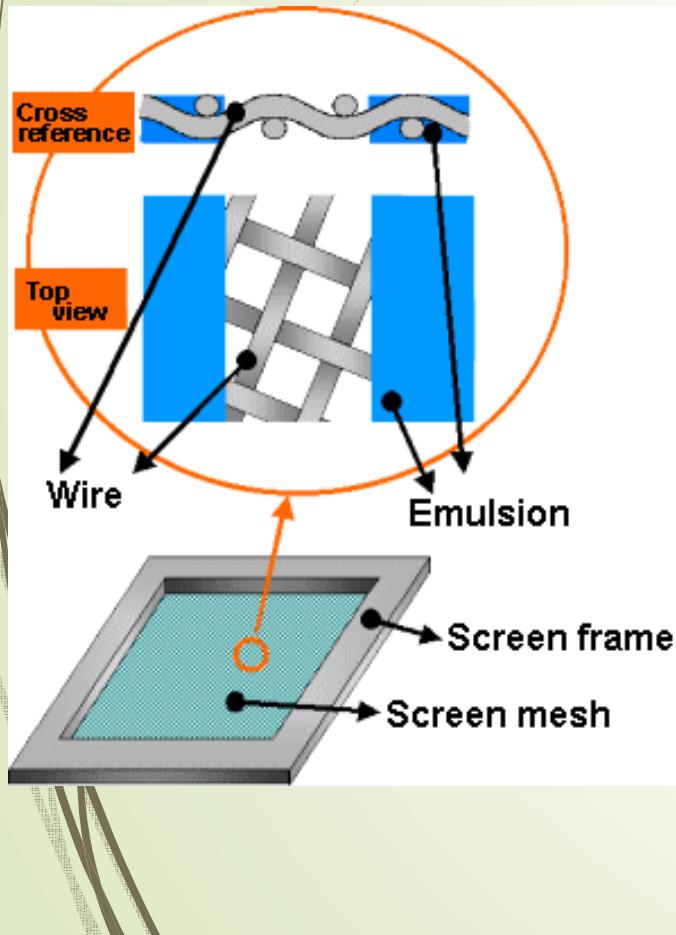


Thick film

- Teknologi 'printing & firing' menggunakan pasta konduktif, resistive, kapasitif dan insulasi yang didepositiskan pada pola (pattern) melalui screen printing dan diproses pada suhu tinggi diatas substrat kramik.
- Ketebalan 5–20 μm
- Resistivitas is $10\Omega/\text{sq}$ - $10M\Omega/\text{sq}$.

Material | Proses | Rekayasa | Karakterisasi | Aplikasi

Material – Thick Film Screen Printing



1. Screen

Screen merupakan tenunan berlubang-lubang yang terbuat dari serat yang fungsinya adalah untuk menentukan pola yang akan dicetak dan menentukan ketebalan pasta yang akan ditempelkan pada substrat.

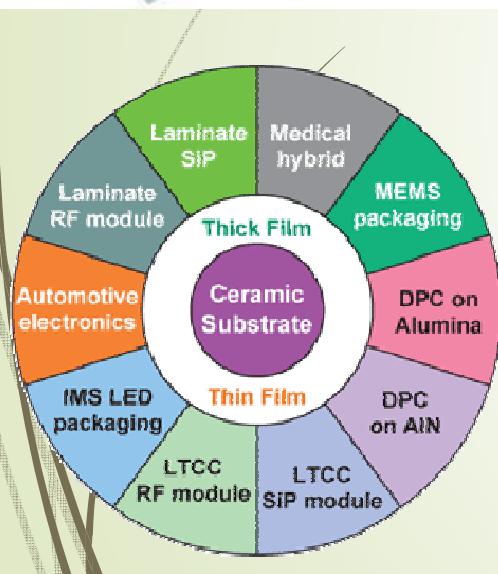
Serat kasa suatu screen terbuat dari yang umum digunakan adalah polyester, nylon dan stainless steel. Umumnya bahan screen yang digunakan dalam proses teknologi ini adalah stainless steel.

Material



2. Substrat

Substrat merupakan tempat jalur interkoneksi rangkaian serta tempat interkoneksi antara divais aktif maupun pasif.

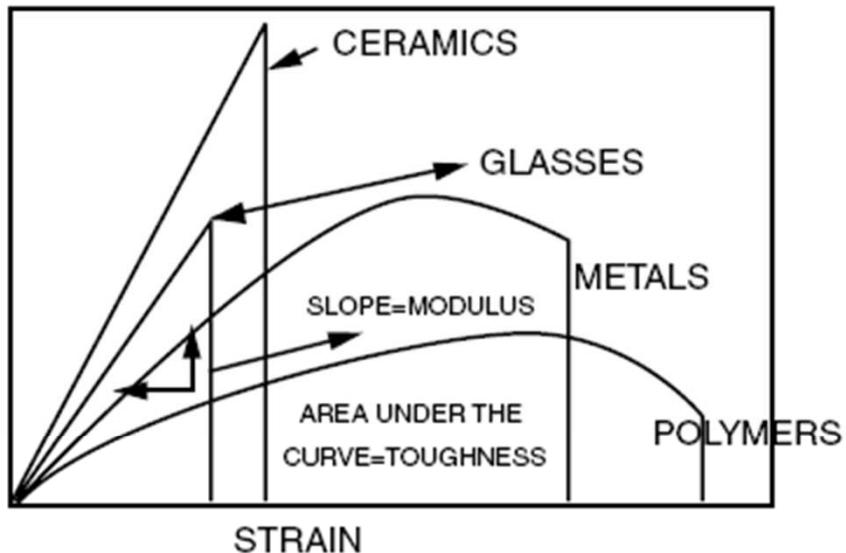


Fungsi Substrat dalam rangkaian film tebal, yaitu:

1. Sebagai penunjang interkoneksi dan perakitan divais.
2. Sebagai isolator dan tempat pelapisan serta pembentukan pola jalur konduktor dan komponen pasif.
3. Media penyalur panas dari rangkaian.
4. Sebagai lapisan dielektrik untuk rangkaian-rangkaian frekuensi tinggi.

Sifat Bahan

STRESS

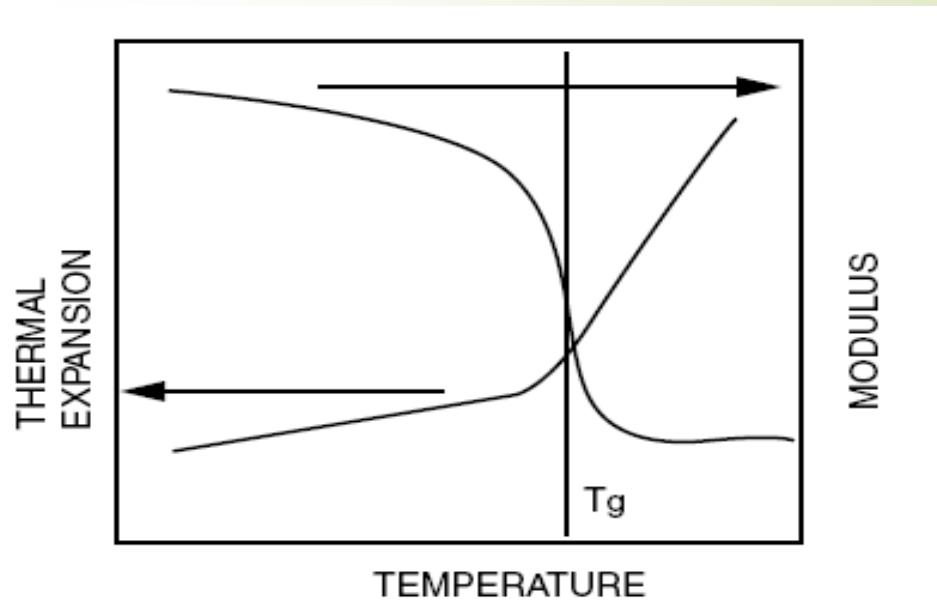


$$\frac{Q_x}{A} = -K_x \frac{dT}{dx}$$

$$CTE = \frac{dl}{l \, dT}$$

Sifat Substrat:

1. Kestabilan dimensi
2. Tahan terhadap gesekan
3. Konstanta dielektrik yang rendah
4. Permukaan rata dan halus
5. Stabilitas kimia terhadap pasta
6. Penghantar panas yang baik
7. Daya serapnya rendah
8. Jenis isolator yang baik



Glass transition temp. phenomena in polymers.

Material

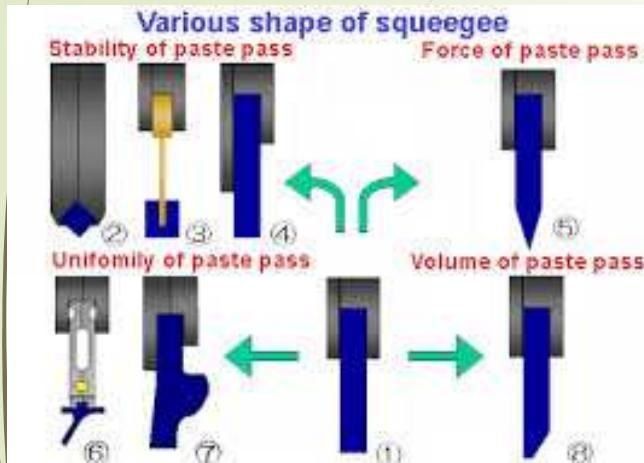


3. Pasta

Macam pasta yang diperlukan dalam pembuatan rangkaian elektronika teknologi hibrida film tebal adalah :

- Pasta konduktor, mempunyai sifat yang berguna untuk solder (*bonding*)
- Pasta resistor dengan berbagai nilai resistansi
- Pasta dielektrik yang mempunyai berbagai konstanta dielektrik dan karakteristik frekuensi.
- Pasta pelindung (*coating*), digunakan untuk melindungi rangkaian akhir
- Pasta solder.

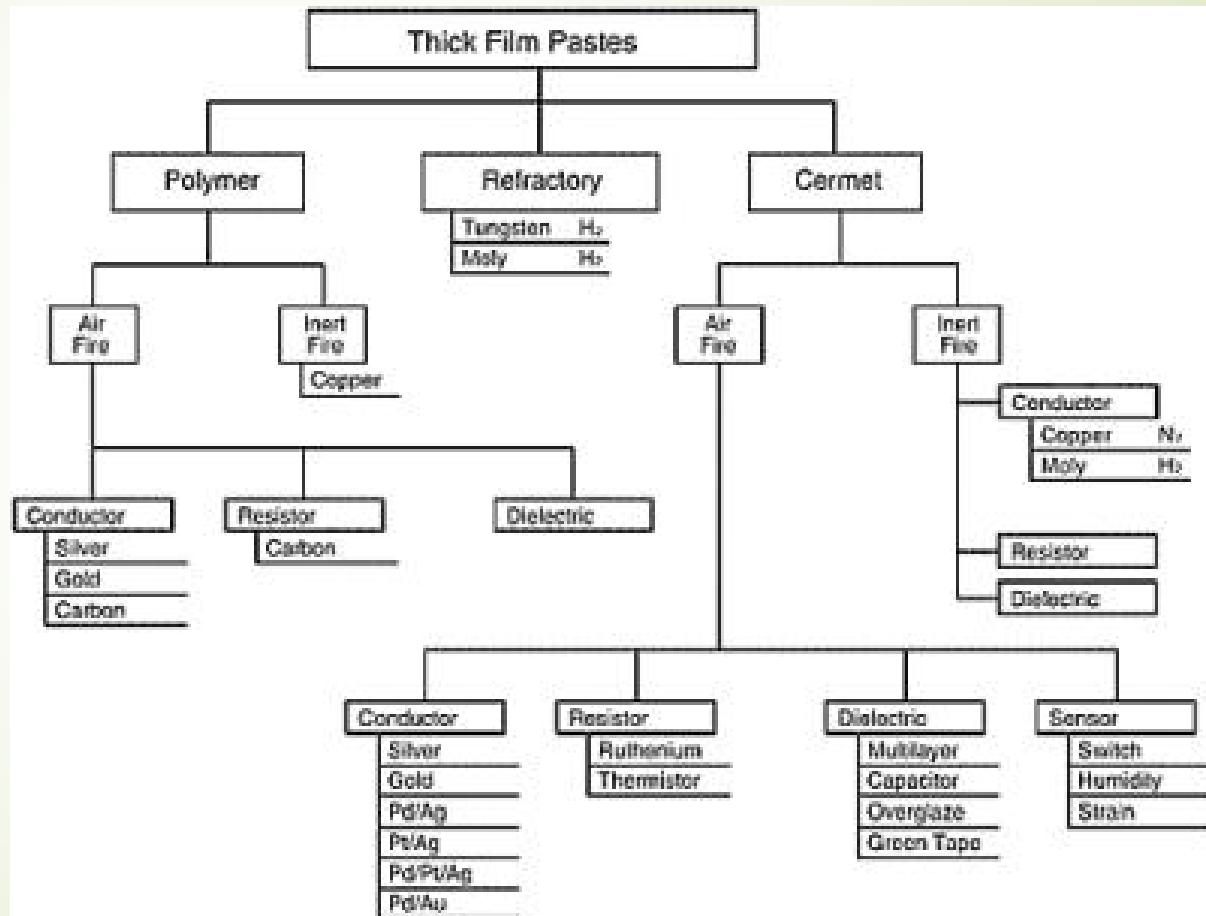
Material



► 4. Rakel

Rakel (squeegee) berfungsi untuk mengalihkan pasta ke substrat dengan cara menekan pasta ke dalam screen. Tegangan permukaan akan menahan pasta pada substrat saat posisi screen kembali ke keadaan semula. Bahan yang digunakan sebagai rakel adalah neoprine, polyrethana dan Viton® dengan kekerasan bahan antara 50-60 durometer. Posisi rakel harus menjadikan sisi tajam membentuk sudut 45 sampai 60 terhadap permukaan screen. Tekanan rakel terhadap screen akan berpengaruh terhadap hasil cetakan. Bila tekanan terlalu ringan maka pasta yang akan dilewatkan screen sangat sedikit.

Pasta Film Tebal



Pasta

Resistance pastes

Paste	Conductive phase	R [Ω/sq]	TKR [$10^{-6}/\text{K}$]
FK9921m	AgPd	0,1	± 100
FK9931m	AgPd	1	± 100
FK9941m	AgPd	10	± 100

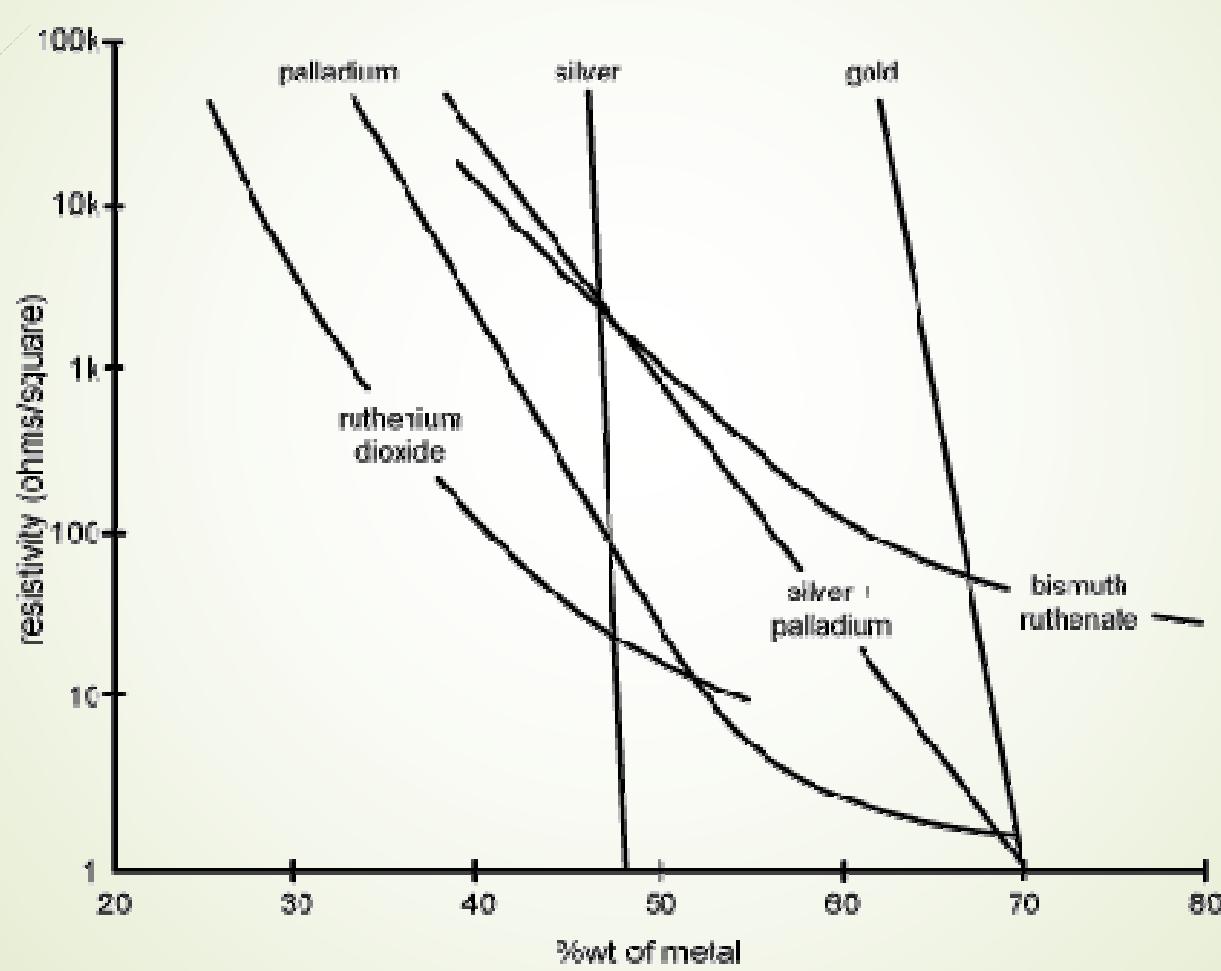
Glass pastes

Paste	Application
FK4027	Cover, 650 °C
FKM4889	Marking paste, green
FKM4891	Marking paste, white
FKM4893	Marking paste, black
FKM4839	Marking paste, red

Conductive pastes

Paste	Conductive phase	R [$m\Omega/\text{sq}$]	Application
FK1205 FK1220	AgPd	< 25	resistance contacts
FK1071	AgPt	< 6	low resistance
FK1282	AgPt	< 35	very good liability

Karakteristik sheet resistivity pasta konduktor (fired)



Material Organik

materials make for excellent insulators

Widespread use in electronics because of their low cost, good dielectric properties, reasonable mechanical properties and ease of processing

TABLE 18.4 Properties of important organic materials in electronics.

Polymer/Polymer Composite	Relative Dielectric Constant	Thermal Expansion Coefficient [ppm/°C]	Approximate Processing Temp [°C]
Epoxy-Kevlar (x-y) (60%)	3.6	6	200
Polyimide-quartz (x-axis)	4.0	12	200
FR-4 (x-y plane)	4.7	16	175
Polyimide	3.5	50	350
Benzocyclobutene	2.6	35–60	240
BT (Bismaleimide triazine)	3.5	50	220
Poly norbornene	2.47	80	250
Cyanate ester-based	2.8	62	220
Teflon™ (DuPont Co.)	2.2	20	400

Proses

Typical thick-film process

Preparation



Screen-printing



Drying/curing



Component assembly



Separation of elements



Firing

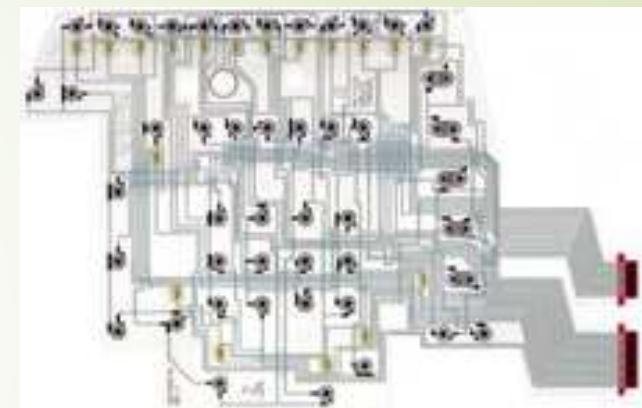
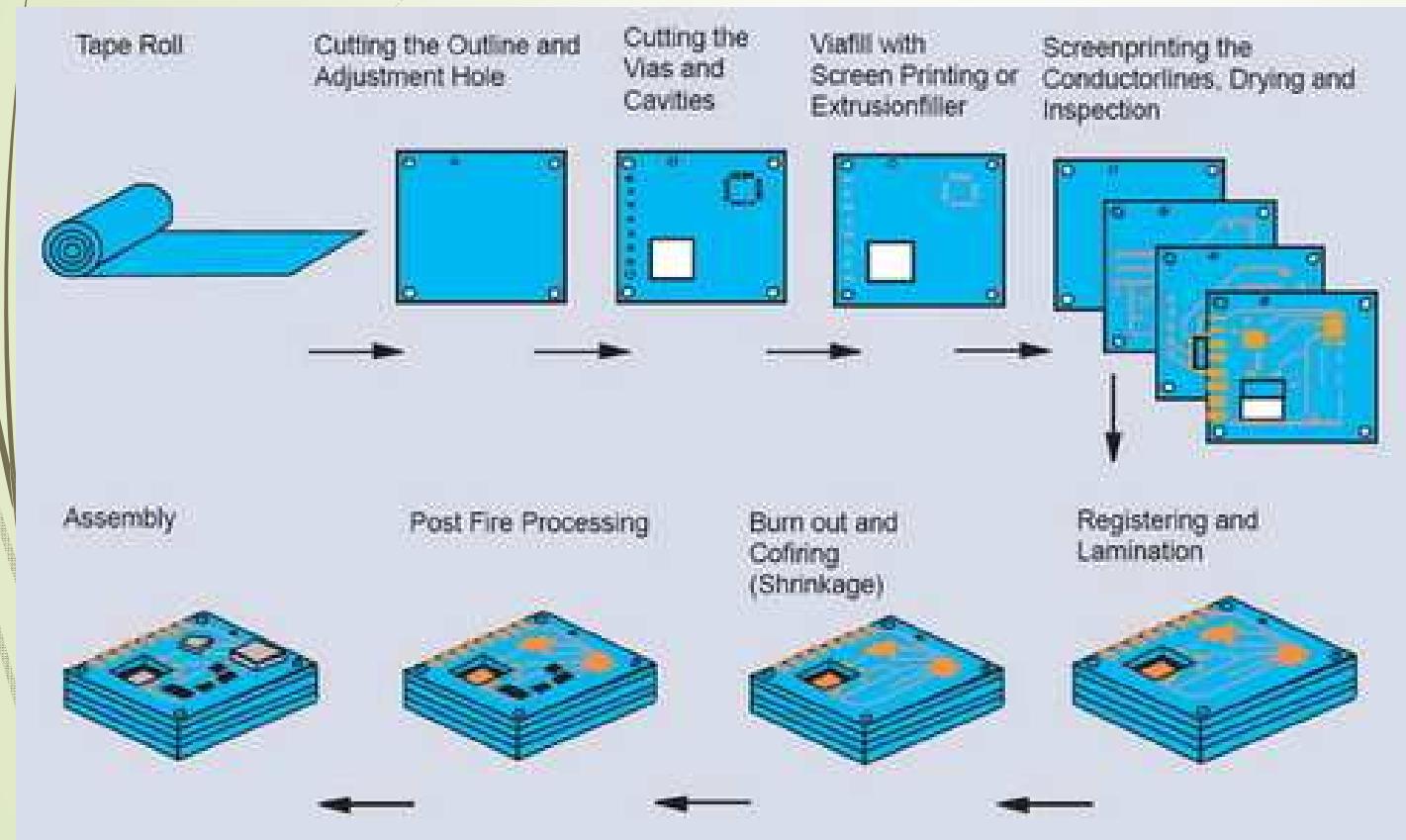
Benefits of thick-film technology

- Reduced physical board area
- High component densities
- Excellent reliability
- Excellent heat transfer
- Consistent performance

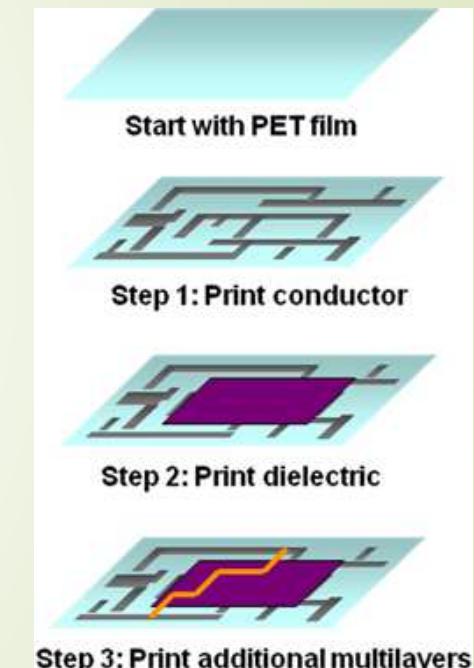
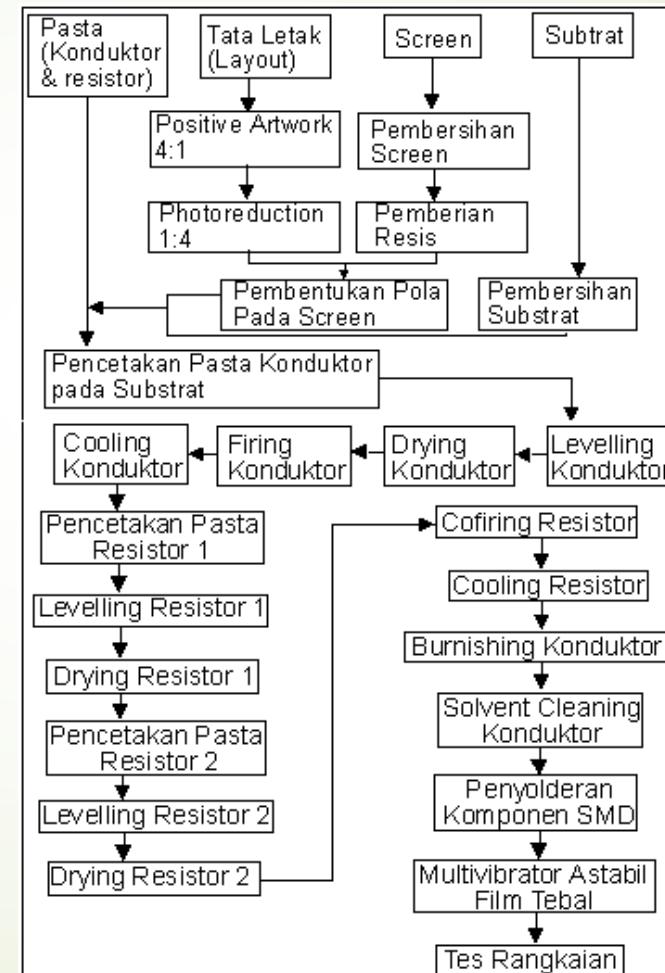
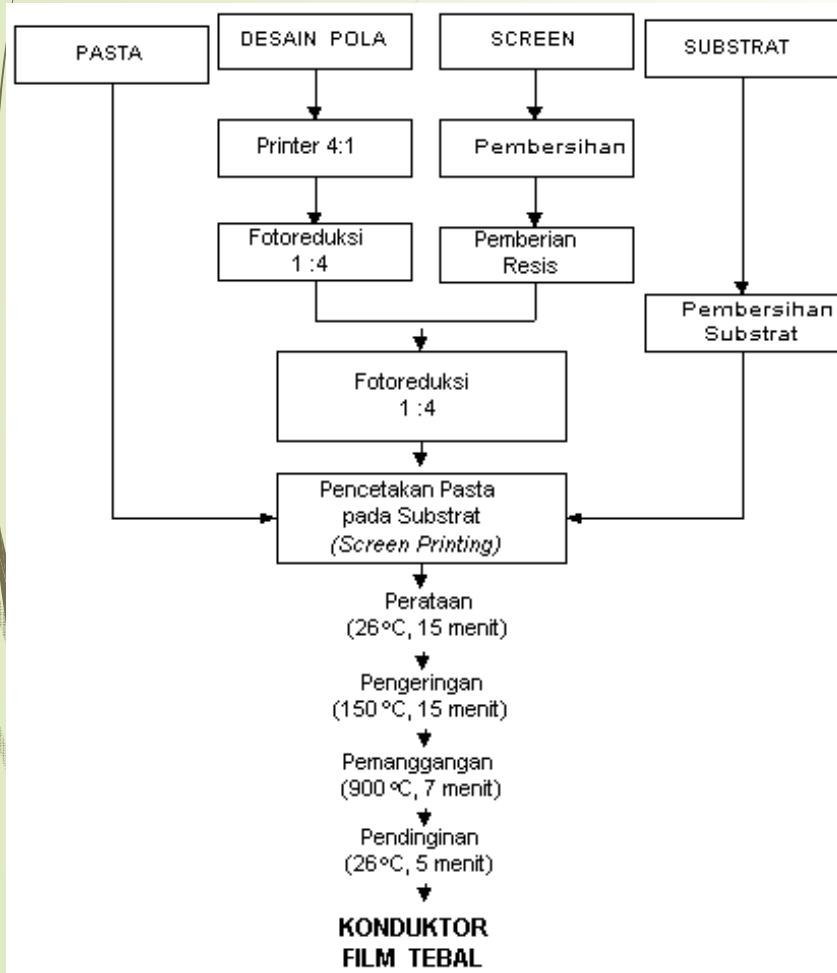
Faktor & Proses Film Tebal



Proses Fabrikasi



Contoh Proses



Teknik Deposisi

Beberapa teknologi untuk deposisi pasta:

- Screen /stencil printing
- Aerosol printing
- Inkjet printing
- Stamp printing or gravure printing..

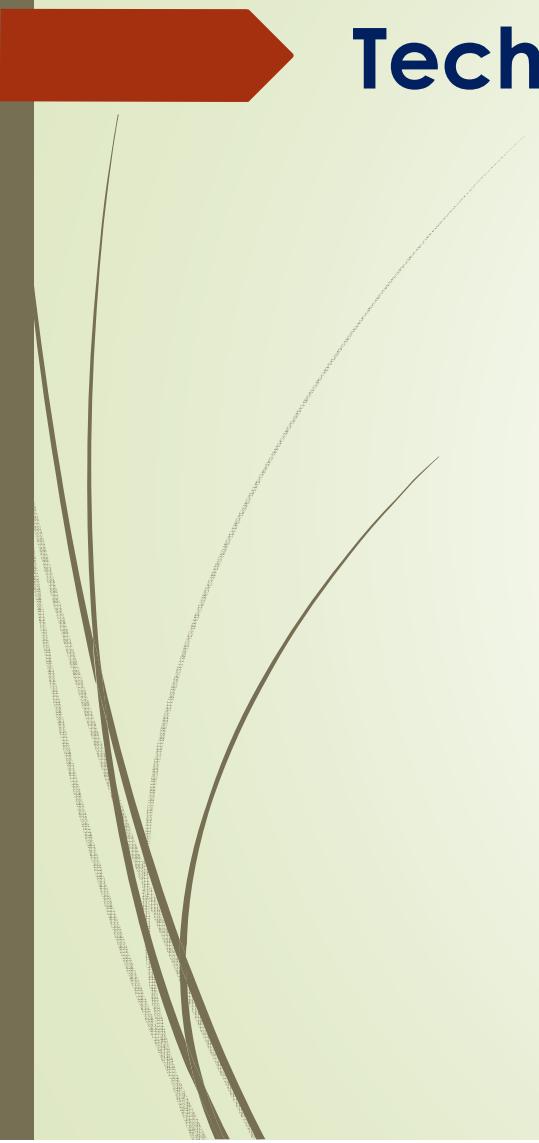
Technical equipment

Development of thick-film pastes

- dispersing (mills, dissolver, roll mills)
Rheometer
- Screen printer for planar and tubular substrate geometries
- Centrotherm furnaces (air and nitrogen), batch-ovens PEO 601

Karakterisasi Lapisan

- **Ofilometer** for planar and tubular substrate geometries
- **REM,EDX,FIB**-preparation
- In situ measurements (resistance, heating microscopy, chemical reactivity)
- Pull/shear tester DAGE
- Resistance measurements, soldering and bonding technology, infrared measurement, electrochemical sensor measurement, impedance measurement
- Temperature, air-conditioning and thermal shock chambers for reliability studies



Technology

- Screen Printing
- Viscometry
- Drying and Firing
- Thickness measurement
- Electrical Measurement
- Resistor trim

Screen Printing

- Presco 435 Screen-Printer



1 mil alignment accuracy

Viscometry

- Viscometer digunakan untuk mengecek viskositas pasta



Tank Viscometer



Stabinger viscometer



Rheometer

Drying Furnace Firing Furnace

- Drying furnaces are used to dry the paste prior to firing. The thickness should be measured after drying.
- Firing furnace sinters (fuses) particles together.



Belt speed and heater temperature sets the profile.

Thickness measurement

- Profilometer – uses a stylus to trace the thickness profile of a printed line.

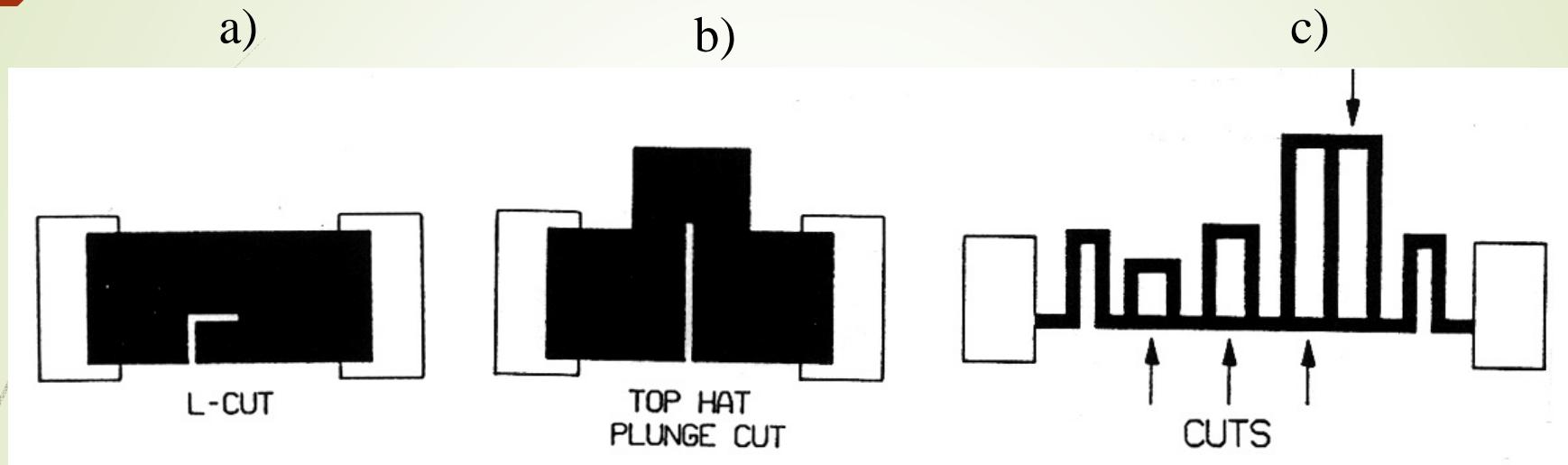


Resistor Trim

- Uses an infra-red laser to trim through a printed resistor – x,y trim stage.



Laser trimming



Bentuk Potongan Trim Laser:

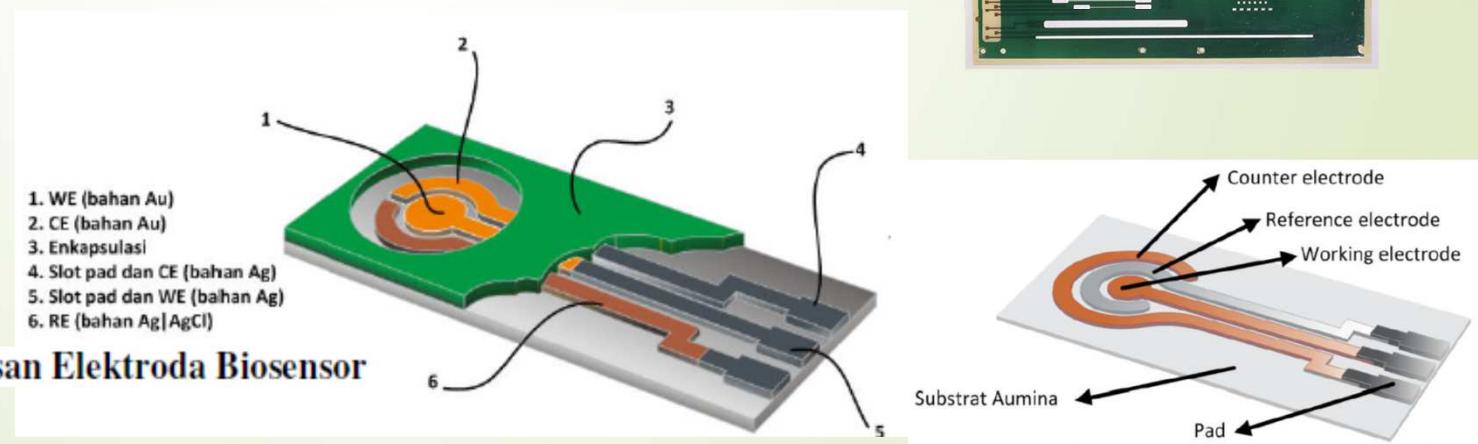
- a): L-cut
- b): Top hat plunge cut
- c): Digital trimming, which is most used for high precision thin film resistors

Aplikasi Film Tebal

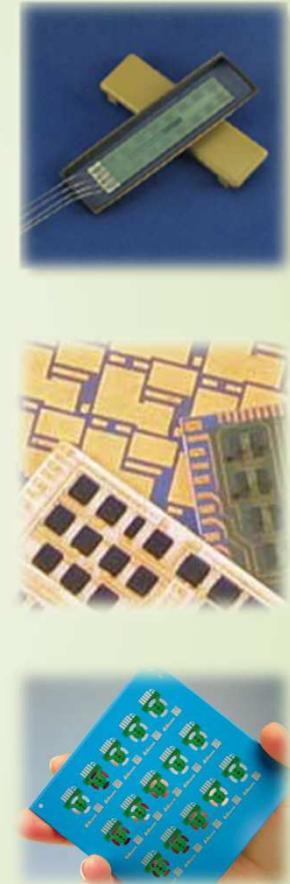
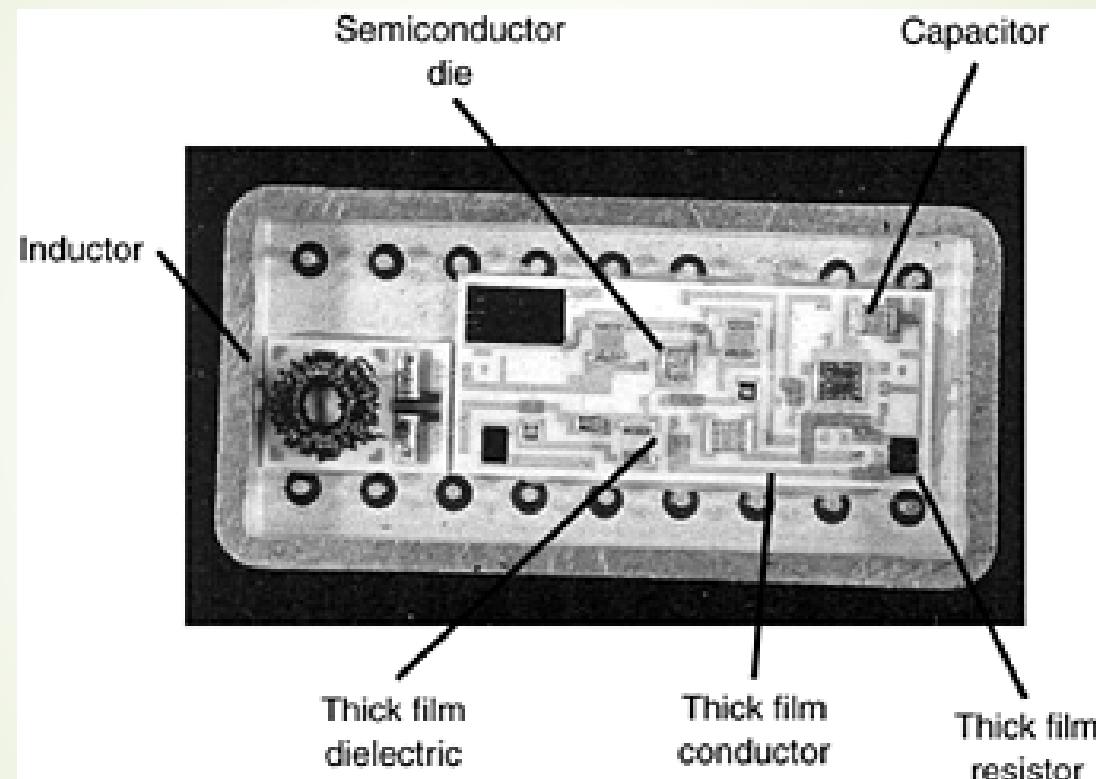
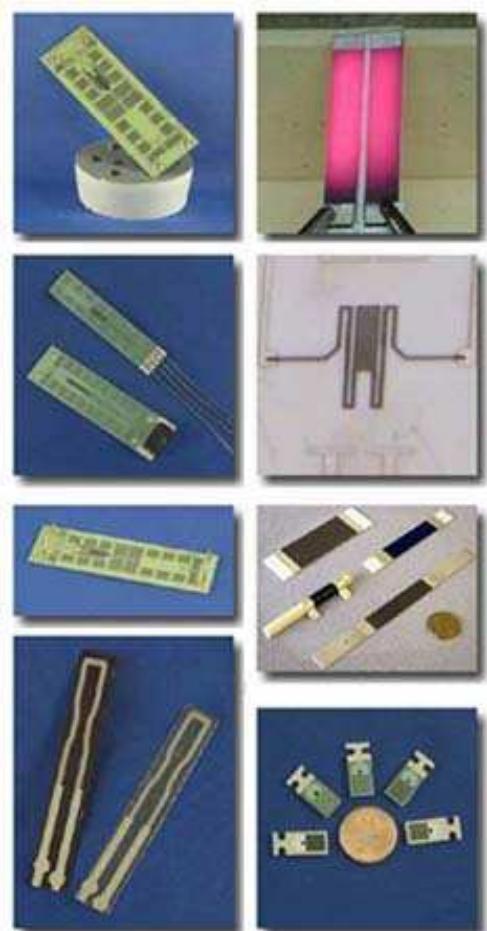
- ▶ Resistor
- ▶ Kapasitor
- ▶ Induktor
- ▶ Sensor
- ▶ Elektroda
- ▶ Solar Sel
- ▶ Display

1. WE (bahan Au)
2. CE (bahan Au)
3. Enkapsulasi
4. Slot pad dan CE (bahan Ag)
5. Slot pad dan WE (bahan Ag)
6. RE (bahan Ag|AgCl)

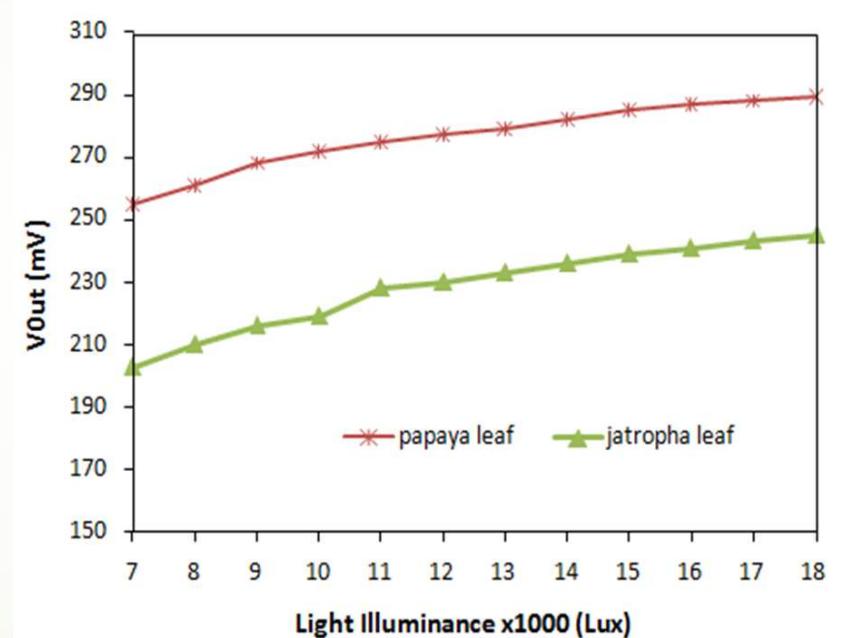
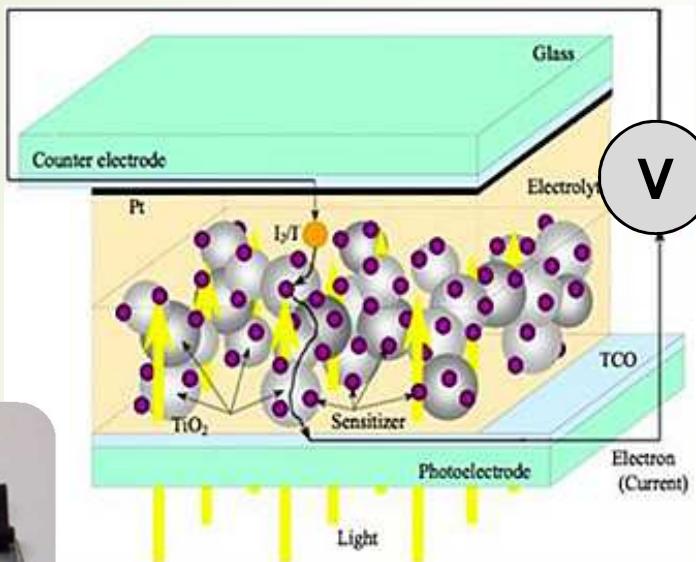
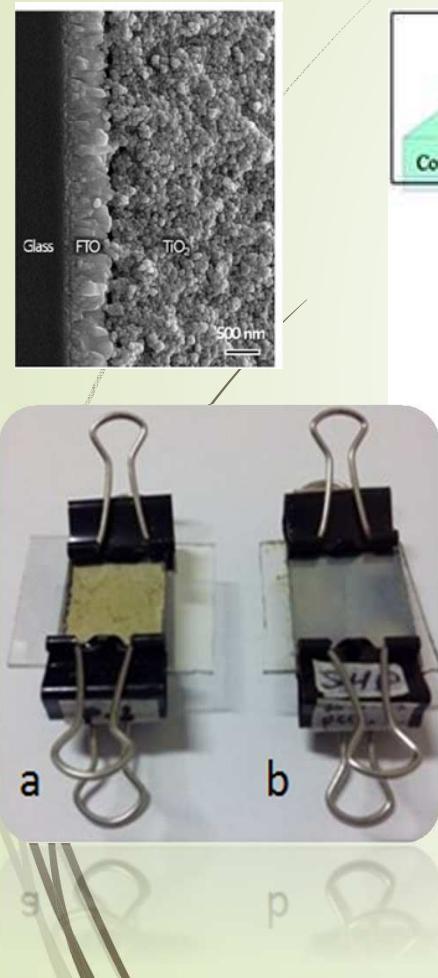
Komposisi Lapisan Elektroda Biosensor



Aplikasi

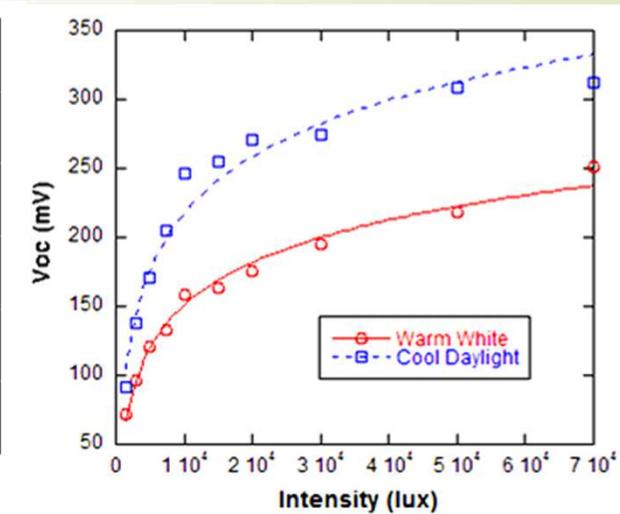
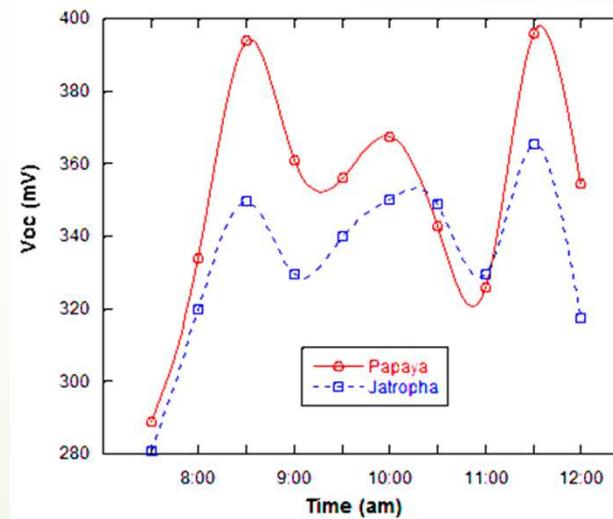
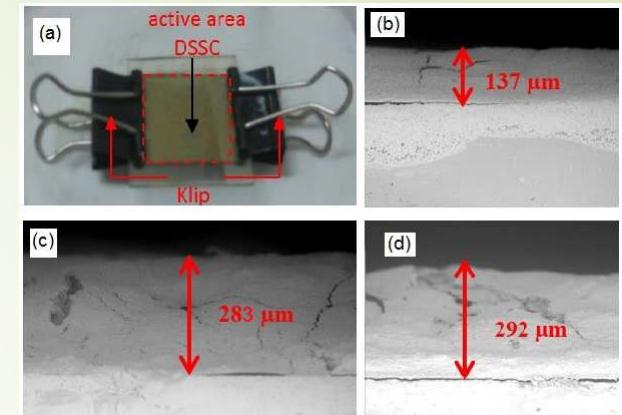
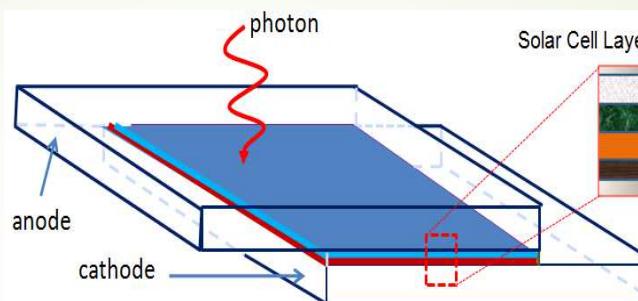
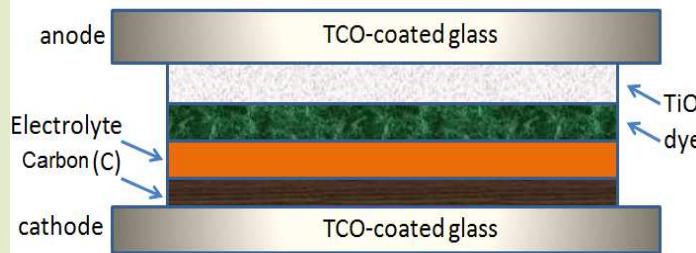


Chlorophyll extraction of papaya and jatropha leaves in DSSC



Sholeh HP, Eka Maulana, et.al. Organic Solar Cell in DSSC 2013

Experimental of DSSC



Eka Maulana, et.al. 2013-2015

References

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- ▶ Pramono, SH; Maulana, E; Fanditya, D; Djatmika, R. (2015). **Characterization of Dye-Sensitized Solar Cell (DSSC) Based on Chlorophyll Dye.** International Journal of Applied Engineering Research. vol. 10 (1). p. 193-205. link
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Characterization of Dye-Sensitized Solar Cell (DSSC) Based on Chlorophyll Dye

¹Sholeh Hadi Pramono, ²Eka Maulana, ³Akhmad Farid Prayogo and ⁴Rosalina Djatmika

^{1,2,3} Electrical Engineering Department, Faculty of Engineering, Brawijaya University.
Jln. Veteran 65145 Malang, Indonesia (author email: sholehpрамоно@gmail.com,
sholehpрамоно@ub.ac.id)

⁴ Chemistry Department, Faculty of Mathematic and Natural Sciences, Brawijaya University. Jln. Veteran 65145 Malang, Indonesia

Abstract

Performance of Dye-Sensitized Solar Cell (DSSC) based on chlorophyll dye that extracted from papaya and jatropha leaves was analyzed in this paper. The optical and electrical characterization DSSCs were investigated using solar radiation and under variation of light illuminations. A sandwich structure was designed by 2x2 cm active area of TCO which has a surface sheet resistivity of 15-25 ohms/sq. Photo-electrode layer using TiO₂ paste is deposited using doctor-blade technique and the counter electrode layer substrate coated with carbon that produced by candle. The parameters that affect to the electrical characteristics of the solar cells were also analyzed and measured using cool daylight and warm white LED. The output DSSC of papaya leaves chlorophyll-based was achieved when Air Mass 1.5 at 8:38 am under solar radiation of V_{oc} and I_{sc} are 393.8 mV and 60 μA, respectively. The I-V characteristic was obtained fill factor of 24.9%. Measured electrical characteristic between two lamps indicated that the cool daylight LED was produce the V_{oc} and I_{sc} greater than warm white LED. The output voltage and current response both of two lamps were investigated increasing exponentially.

Key words: DSSC, Chlorophyll Dye, light illumination, Air Mass.

Effect of Chlorophyll Concentration Variations from Extract of Papaya Leaves on Dye-Sensitized Solar Cell

Eka Maulana, Sholeh Hadi Pramono, Dody Fanditya, M. Julius

cost-efficiency of production, flexible substrates, and low-cost materials.

Dye commonly used is Ruthenium (*Ru*) complex as this type of synthetic dye was almost close to pure resulting in an efficiency of 11% [5]. Due to the dye Ruthenium is high cost to obtain, so in this paper used chlorophyll dye substances obtained from papaya leaves. The dye role on DSSC acts as the photon absorption and then a process of excitation of electrons in the dye molecules to produce electrical energy [6]. The dye ability absorbs the photon is very important thing due to there is need for characterization. The characterization needed to determine ability of dye absorbs photons and will further affect the output power generated combined by TiO₂ layer [7]-[9]. Photon absorption level by chlorophyll dependent on the concentration of chlorophyll which is influenced by the amount of leaves used the solvent concentration and the duration of chlorophyll release process at stirring time. This paper investigates the effect of variations of this combination to obtain characteristic of the DSSC performances.

Tugas I - Mikroelektronika

- ▶ Jelaskan beberapa metode teknik deposisi Teknologi Film Tebal berikut:
Chemical Bath, Spin-Coating, Dip-Coating, Doctor Blade, Metering Rod, Slot-casting, Spray-coating, Screen Printing, Inkjet Printing, dan Aerosol Jet.
- ▶ Tentukan desain dan kajian teknologi Film Tebal terkait dengan : <pilih salah satu>
sensor, solar sel, display, hybrid device component, dll

Email: ekamaulana@gmail.com

Subject: Tugas Mikroelektronika I - Nama