THIN FILM DEPOSITION, STRUCTURING AND ANALYSIS ON WAFER LEVEL (200 mm)

The Fraunhofer FEP, department Organic Microelectronic Devices, disposes of a wide array of processes, available under clean room condition. The equipment is geared on the development and manufacturing of OLED microdisplays.

The main focus lies on the deposition and structuring of organic and inorganic layer in nm up to µm range and their patterning. For this purpose several tools and processes are available. It stands to reason that analytical methods for thin film characterization are available.

The opportunity to combine different processes and tools is to emphasize. If needed layer and layer stacks can be thin film encapsulated, to protect them from moisture and oxygen.

The Fraunhofer FEP offers the opportunity to combine evaporated and spin-coated materials with various anode/cathode materials to be finally encapsulated and structured on pilot line quality.

Another highlight is the alignment accuracy of ±10 µm for shadow masks during layer deposition and argon etching.

Beside of layer deposition and structuring the bonding of wafers and substrates is an important process. Color filter wafer can be aligned with an accuracy of ±1 µm and bonded under vacuum. Also processes for temporary bonding are available.
Deposition of single layer and layer stacks
Deposition of single layer and layer stacks with a thickness of $\geq 1$ nm on max. 200 mm silicon or glass wafer or also on foils.

**Deposition:**
- Organic materials, especially organic semiconductors from solution, e.g. polymers (PEDOT:PSS, P3HT) or from gas phase (e.g. Alq3, C60, Phthalocyanines)
- Metals (e.g. Ag, Ca, Al)
- Metal oxide compounds (e.g. MoO$_x$, AlO$_x$, SiO$_x$, TiO$_x$)
- Thin film encapsulation by Barix multilayer / Vitex process ( WVTR $< 10^{-5}$ g/m$^2$d)

**Particle measurement**
*Particle measurement tool Surfscan 7700 by KLA-Tencor*
- Analysis of structured and unstructured wafers
- Detection of defects/particles $\geq 0.15$ µm
- 30 mW Argon ion laser, wavelength: 488 nm
- Variable input polarization

**Structuring of layers by**
- Shadow masks
- Dry etching with Argon and/or Nitrogen in combination with 1:1 lithography

**Bonding**
*Wafer Bonder (EVG 520)*
- Substrates: typical 150/200 mm wafer, substrate stacks up to 9 mm
- Mechanical pressure: 0 – 40 kN
- Chamber gas: vacuum $10^{-3}$ mbar, N$_2$, other gases by request
- Voltage/current: 2 kV/50 mA
- Room temperature up to 550 °C
- Bond processes: adhesive, fusion, eutectic, anodic

*Mask Aligner (EVG IQ-Aligner)*
- Substrates: 150/200 mm wafer, typical thickness 0.5 up to 6 mm
- Alignment accuracy: $\pm 1$ µm (top and bottom side align)
- UV exposure: 365 nm, 20 mW/cm$^2$, 5% uniformity
- Available processes: bond align, IR align, wafer stack align, mask align

*Automatic Spin-/Spray-Coater + Bonder + Aligner (EVG Hercules)*
- Wafer encapsulation for 200 mm wafer
- Coat (spin/spray), bake, cool, bond, align, expose

**Photo lithography**
- Substrate size: 200 mm wafer (typ.)

**Tools:**
- Brewer Spincoater for photo resist deposition
- Laurell spincoater in glovebox (dry N$_2$ atmosphere)
- EVG wafer aligner/exposure system
- Leybold Optics vacuum cluster for dry etching via O$_2$-RIE and Ar-ion mill

**Electro-optical tests**
*Ellipsometer WOOLLAM M-2000F*
- Spectroscopic ellipsometry at 1 nm up to 25 nm thin layer
- Wave length range: 245 – 1000 nm
- 200 mm wafer chuck, smaller samples possible
- Fully automated stage (x, y, z)
- Automated alignment (Align 200)
- Option: 50 µm focusing probes

*Filmetrics F50*
- Reflectometer: measurement at 30 nm up to 50 µm thick layers (wavelength range 380 – 1050 nm)

**Electro-optical characterization**
*(Wentworth wafer prober)*
- Luminance-Current-Voltage (UV)-measurement on 200 mm wafer level
- Automatic wafer and chip measurement using probe cards