



— *turning ideas into solutions*

mBRAUN

OLED/PLED PROCESS TOOLS

GLOVE BOX INTEGRATED OR STAND ALONE SOLUTIONS

THIN FILM TECHNOLOGY



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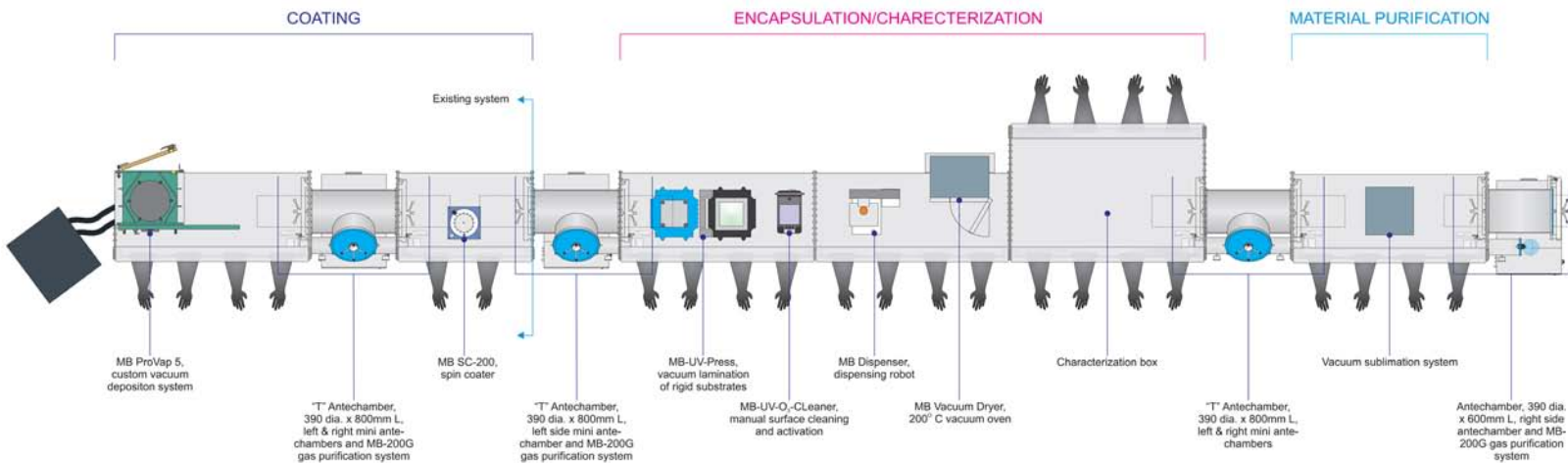
RESEARCH • DEVELOPMENT • PRODUCTION

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Introduction – OLED/PLED Process Tools

In addition to glove boxes, inert gas purifiers, solvent purifiers, and vacuum deposition systems, MBRAUN offers a full line of standalone and glove box integrated OLED process tools. These tools are commonly used for the preparation, coating, and activation of thin film substrates. MBRAUN manufactures manual laboratory process tool workstations for research and development up to fully automated process tool workstations for pilot scale and mass production applications. Typical configurations consists of multiple glove box modules that have separate atmosphere conditions related specifically to the process. For example inert gas glove box modules with an integrated vacuum deposition system connected via a t-shaped antechamber with a second inert gas glove box module with integrated process tools for further wet coating such as spin coating and slot die coating. A third inert gas glove box module for glass preparation using UV cleaners, desiccant dispensers, getter mounting systems and vacuum lamination units with UV curing capabilities. The entire OLED making process can be realized inside an inert gas glove box enclosure.

In addition to the variety of process tool offerings, MBRAUN can design the inert gas glove box enclosure with laminar flow, ambient atmosphere as well as clean room class 1 conditions. Below is an example of an inert gas glove box set up for the research and development of OLED's utilizing glove box modules separated by t-shaped antechambers. A brief description of our process equipment for thin film applications is also provided. Please note typical configuration will vary depending on the process and customers budget. Please visit www.mbraun.com or email info@mbraun.com for more information.



C Coating Module - MBRAUN offers a full line of thin film coating equipment for all your application needs. Our complete line of coating products include thin film deposition systems, spin coaters, inkjet printing, and slot-die coating.

E Encapsulation Module - The lamination/encapsulation of substrate to cover glass is an extremely critical, complicated and important step in creating an OLED device. An effective encapsulation of the substrate can provide essential protection of the active layers from harmful components like oxygen and moisture as well as mechanical stress. The process tools located within this module usually is the last step bringing together a fully coated substrate and cover glass for encapsulation.

MBRAUN offers a full line of curing and cleaning process tools in order to create an effective OLED device. Products include hi temperature ovens, vacuum hotplates, uv press encapsulation, and uv cleaners. The entire process can be carried out under inert atmosphere conditions with optional laminar flow integration for working in class 1 environments.

UV-Cleaning – Surface cleaning and activation

The MBRAUN UV-Cleaner is a highly effective pre-treatment process for the removal of molecular organic contaminations and surface preparation via intense ultraviolet light. As a result clean, hydrocarbon-free optical surfaces with significantly improved thin film and UV resin adhesion characteristics are achieved.

- Hermetically sealed process chamber
- Designed for glove box operation
- Easy processing
- Long-term operational reliability
- Room temperature process
- UV grid lamp with safety interlock
- Quick change system for UV-lamp
- Operates at atmospheric pressure with ambient air or oxygen
- Multiple gas ports for introduction of process gases
- Substrate stage with adjustable sample to lamp distance
- Simple operation and compact footprint



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Vacuum Hotplate – Sensitive layer curing

Heating under vacuum environments allows curing at modest temperatures, addressing the sensitivity of organic materials to elevated temperatures. Three different incorporated bake modes in combination with MBRAUN's proprietary proximity heating function allow a high level of flexibility to define the optimal curing conditions.

- Exceptional temperature uniformity
- Layer curing under controlled process conditions
- Soft bake function
- No "temperature shock" and "substrate warping"
- 3 different operation modes
- PLC with central operation panel
- Programmable recipes
- Vacuum process chamber
- Glove box integrated or stand-alone



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Slot-Die Coating – Efficient coating of thin layers

The slot-die coater setup allows for efficient, highly-uniform, spin-less coating of a wide variety of organic materials onto substrates of up to 200 x 200 mm. A robust platform and precisely machined components create high material yields along with minimal operating and maintenance costs.

- Able to coat organic or inorganic liquids on flexible or rigid substrates
- Available for R&D as well as gen2 through gen8 substrate processing
- Extremely accurate fluid dispense rates and volume control
- Minimal equipment footprint requirements
- Low fill volume option limits lot size of high cost polymers and other materials
- Multi-head configuration with pattern coating capability
- Main control with graphical user interface (GUI)
- Optimized for OLED lighting applications

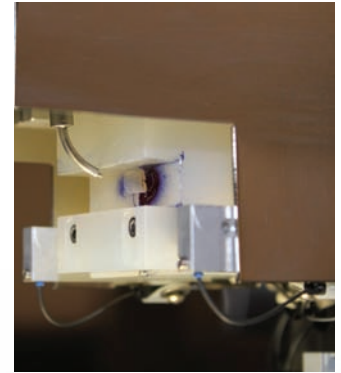


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Edge Bead Remover – Selective layer removal

Cleaning the edges from organic layers is the prerequisite for an optimized subsequent encapsulation of the organic device. The removal process itself utilizes a high velocity solvent jet. By directing the solvent jet towards the organic layer and moving the nozzle parallel to the substrate edge, a precise and accurate removal is achieved.

- Edge bead removal for rectangular substrates
- Selective removal of organic layers
- Main control (PLC) with graphical user interface (GUI)
- Recipe programmable solvent jet nozzle (speed, position)
- Substrate top side solvent rinsing with solvent exhaust
- Automatic edge detection



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Spin Coating – Wet coating of thin layers

Usually deployed in R&D and pilot scale systems, spin coating is a common technique used to apply uniform thin films to flat substrates. MBRAUN offers a compact, vibration free and inert gas compatible design which makes it a versatile and vital tool in every research facility.

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|---|---|
| • Stand alone and/or glove box integrated configuration | • Recipe programmable process parameters |
| • Wafers up to 8" or substrates up to 6"x6" | • Main control with human machine interface (HMI) |
| • Standardized and customized vacuum chucks | • Comprehensive set of optional upgrades |
| • Speed from 100 up to 7000 rpm | |

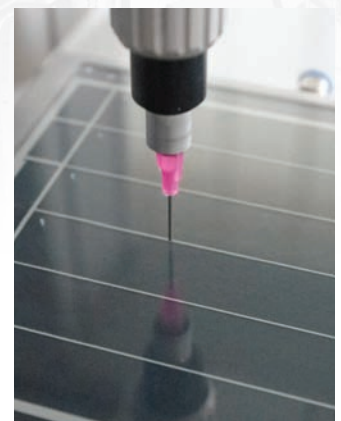


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Adhesive Dispensing - Glass-to-Glass sealing adhesive

MBRAUN's bench top XYZ dispensing robots provide total control over adhesive placement, from controlled beads, lines, arcs and circles to repeat timed dots. Programming is simple via the teach pendant so that even complex patterns can be created quickly. High dispensing speeds are achieved reducing process times whilst placement accuracy of the adhesive ensures absolute minimum waste material, no mess and a guaranteed minimal error rate.

- Fully 3D programmable structures
- High precision XYZ robot
- Process optimized dispensing tools
- Optional Windows based programming software



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Plasma Cleaning – Cleaning and activation

The Plasma unit is an integrated low-pressure plasma platform with the main purpose to activate and clean semiconductor and optical surfaces from organic contaminants. It finds frequent use in the electronic and semiconductor industries as well as in scientific research fields including biology, chemistry, physics and materials science.

- Welded aluminum vacuum chamber
- Single horizontal electrode
- 125 Watts @ 50 kHz R.F. generator
- Precision needle valve flow control
- Pirani vacuum gauge
- 5 CFM Oxygen service vacuum pump
- Single process sequence



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UV Curing – Curing of adhesive material for Glass-to-Glass lamination

The MB-UV-Cure is part of the MBRAUN encapsulation process tool series specifically designed for applications in the organic electronics marketplace. The basic function is to encapsulate rigid substrates with a cover glass under ambient pressure conditions using a high intensity UV source.

- High intensity UV source
- Curing of epoxy resins
- Short curing time
- Fe doped UV lamp (suitable for most UV resins)
- Cost efficient



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Vacuum Press – Glass-to-Glass vacuum press for lamination

The MB-VacuumPress setup allows for the lamination of substrate and cover glass under vacuum conditions creating a bubble-free end-sealing of the device. Underrated from many who entirely focus in their research on creating an optimized organic material stack the lamination is an extremely critical, complicated and important step in the entire OLED process. Usually it represents the final step before the OLED's can be transferred out of the inert environment.

- Transparent vacuum chamber for evacuation < 1mbar
- Mechanical alignment and fixation of substrate and cover glass
- Substrate size up to 150x150mm possible
- Exchangeable substrate and cover glass chucks for high flexibility
- Vacuum gauge
- Precise lamination with screw drive
- Easy integration in inert gas glove boxes
- Manual operation



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Vacuum Press – Glass-to-Glass vacuum press with UV for lamination

The design of the MB-UV-Press comes into consideration when a system is required that combines the accuracy and precision of an automatic process control with the economically favorable way of manual loading and unloading.

- Stand alone unit or glove box integrated
- Non-contact, gas pressurized lamination
- Black anodized, vacuum process chamber
- Fully glovebox integrated & standalone unit
- Mechanical Glass-2-Glass alignment
- Automated PLC controlled process
- Modular chucks for variety of substrate sizes and shapes
- Square substrates up to 8" x 8"



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Vacuum Drying – Cleaning and curing of sensitive material

The MB-VacuumDryer represents the most economical solution for air-sensitive substances and thermally instable products that require drying under controlled conditions in a dust-free vacuum atmosphere.

- Maximum operating temperature 200°C
- Special glove box integration
- Meets GLP and GMP standards
- Pressure safety system with door safety catch
- Constant pressure and temperature performance
- Menu with vacuum level control
- Easy cleaning
- High quality design
- CE compliant



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Vacuum Deposition – Physical vapor deposition systems

Vacuum deposition is a family of processes used to grow layers of material onto substrates under vacuum conditions. There may be multiple layers of different materials with thicknesses that can range from less than 1 nm to several microns. MBRAUN offers a number of products for thin film deposition applications. Our systems can either be glovebox integrated or offered as standalone units.

- Compact, space-saving designs available
- Shielded view port for visual process monitoring
- Recipe programmable PLC control
- Compatible with most standard deposition sources
- Manual or automatic operation available
- Removable protective shielding
- Ergonomic to operate, easy to clean
- Easy integration in inert gas glove boxes
- For substrates up to 300x300 mm



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Vacuum Oven – Cleaning and curing of sensitive material

The MB-VOH-series has become the industry standard in oven technology and is being utilized in applications that include university research as well as in industrial manufacturing. The VOH oven sets the standards when controlled heating under vacuum and/or inert conditions is required.

- Designed specifically to operate under vacuum conditions
- Easy transfer of goods into and out of the glovebox
- Available as both standalone and glovebox integrated versions
- Maximum temperature up to 600° C
- Maximum vacuum level 5×10^{-2} mbar
- All stainless steel construction
- Internal heating coil
- Inner and outer door open in vertical direction

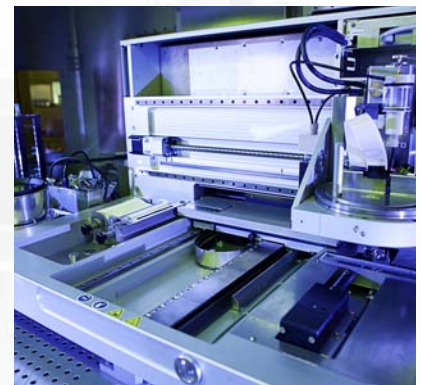


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Ink jet Printing – Printing thin film substrates

Inkjet printing is considered being one of the most versatile techniques in modern coating applications as it provides the opportunity to deposit all kinds of structures starting at the μm -level up to large area coatings.

- Substrate treatment
- Inkjet printing head
- Product manufacturing process
- Post process
- Device design
- Ink Jet printing system
- Jetting and printing process



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Other options to consider:

- Laminar flow integration
- Clean room class 1
- Depositing techniques such as sublimation systems, atomic layer deposition, inkjet printers etc.
- Custom shelving and transport systems
- Integrated ovens such as convection ovens or hi-temperature
- Regenerable solvent vapor removal system
- Getter mounting and dispensing systems
- Antechambers and loadlocks
- Solar simulators
- Static eliminators
- And more

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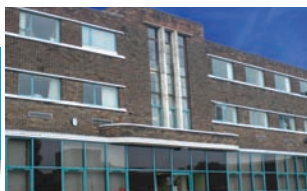
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