

Competence Matrix for Plastic Electronics in Germany. Section 1: Universities and Institutes

	Fraunhofer Institute - Applied Polymer Research (IAP)	Technical University Darmstadt: Institute of Printing Presses and Printing Methods (IDD)	Fraunhofer Institute - Integrated Circuits (IIS)	Fraunhofer Institute - Manufacturing Engineering and Automation (IPA)	Fraunhofer Institute - Photonic Microsystems (IPMS); COMEDD - Centre for Organic Materials and Electronic Devices	Fraunhofer Institute - Silicate Research (ISC)	Fraunhofer Institute - Solar Energy Systems (ISE)	Fraunhofer Institute - Reliability and Microintegration (IZM)	Darmstadt University of Technology - Competence Centre Printed Electronics (IDD)	HSG-IMIT	Max Planck Institute for Polymer Research	Max Planck Institute for Solid State Research	Physikalisch-Technische Bundesanstalt (PTB)	pmTUC - Institute of Print and Media Technology at Chemnitz University of Technology	Stuttgart Media University (HdM)	Technical University of Darmstadt - Institute of Printing Presses and Printing Methods (IDD)	Technical University of Dresden - Institute of Applied Photophysics (IAPP)	TITV Greiz (Institute for Special textiles and flexible materials)	University of Stuttgart - lab of the Chair of Display Technology	University of Wurzburg - Faculty of Physics and Astronomy
(2) Materials and Technologies																				
THIN FILM PROCESSING FACILITIES AND STATUS																				
(Cleanroom) facilities and main activities:																				
<i>R&D (lab-scale processes; exploratory stage; core technology developer)</i>																				
<i>Prototype Line (engineering sample volumes; yield and SPC control)</i>																				
<i>Production line (fully-balanced; shift systems; volume output)</i>																				
SUBSTRATE TYPE AND PREPARATION																				
Plastic:																				
Other "flexible":																				
<i>Stainless steel/metal foil</i>																				
<i>Paper</i>																				
Applicable to rigid substrates																				
Substrate barrier/encapsulation/planarisation layers																				
MAIN THIN FILM PROCESSING STEPS																				
Printing/Additive processing:																				
<i>Low resolution, comparatively thick layers (e.g. screen, gravure, offset..)</i>																				
<i>High resolution, comparatively thin layers (e.g. inkjet, soft lithography..)</i>																				
Mechanical masking																				
Direct write/materials modification (e.g. laser ..)																				
Sheet deposition of materials from solution - e.g. slit coating, spin coating.																				
Vacuum-based sheet materials deposition																				
Conventional photolithography with wet/dry etch for material definitior																				
Process Type:																				
<i>S2S/batch processing</i>																				
<i>R2R/continuous processing</i>																				
MATERIALS AND DEVICES																				
Main Device Type classification																				
<i>Active device elements (e.g. (O)TFTs, diodes, PV, PLED..)</i>																				
<i>Passive device elements (e.g. antennas, interconnect, electrodes..)</i>																				
<i>Generic PE applications</i>																				
Main Material Type classification																				
<i>Semiconductor</i>																				
<i>Dielectric/Passivation layers</i>																				
<i>Matrices and interconnect; transparent conductors</i>																				
<i>Bio/pharma/medical materials</i>																				
<i>Nanotechnology (e.g. tubes, wires..)</i>																				
<i>Phosphors, light emitters, lasers ..</i>																				
<i>Surface modification, surface energy patterning..</i>																				
<i>Coatings, release films..</i>																				
<i>Generic Materials base Research/know-how - suitable for PE devices</i>																				

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(2) Materials and Technologies (contd.)																				
ENCAPSULATION LAYERS FOR ..																				
Backplane/active driving elements:																				
Frontplane (e.g. display media, sensor elements..):																				
Generic encapsulation layers for PE applications																				
DISPLAY EFFECTS																				
OLED - emissive:																				
Small molecule OLED																				
Polymeric OLED																				
Electrophoretic - reflective																				
Electroluminescent/phosphor-based																				
LC-based																				
Generic display effects																				
SIMULATION AND MODELLING																				
Materials structure and chemical performance simulation																				
Materials/device simulation & architecture design (at elemental device &/or pixel level)																				
Circuit simulation and architecture design (e.g. backplane array, RFID circuit)																				
Thin-film processes (e.g. printing and coating rheology..)																				
Manufacturing processes																				
BACK-END INTEGRATION																				
Electrical contacting to e.g. discrete Si IC drivers via flex-foils																				
Electronics packaging and integration (e.g. module assembly..)																				
FAILURE ANALYSIS, TEST, METROLOGY ETC.																				
Development of core testing techniques																				
Test and Measurement:																				
Electrical																				
Optical/Geometric																				
Chemical																				
Lifetime/environmental/mechanical																				
Level of testing:																				
Single/few devices only																				
Component/prototype line/production level																				

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(3) Specific Applications and/or Products																				
Generic "flexible displays/electronics"																				
DISPLAYS																				
Component Level:																				
<i>Backplane AM drivers</i>																				
<i>Display biplanes (backplane + display media)</i>																				
Applications and Mechanical metrics:																				
<i>High end (greyscale/colour..)</i>																				
<i>Low end (signage, PoP, ESL, indicator displays..)</i>																				
<i>Rigid only</i>																				
<i>Conformal (fixed RoC)</i>																				
<i>Flexible/bendable (multiple RoCs)</i>																				
<i>Rollable (full mechanical flexibility to minimum RoCs)</i>																				
RFID																				
<i>Antennas only</i>																				
SMART CARDS/PACKAGING																				
NOVELTIES/GAMES/DISPOSABLE ELECTRONICS																				
PHARMA/MEDICAL/BIO APPLICATIONS																				
LARGE AREA SOLID STATE LIGHTING																				
<i>Emissive element based on ... materials:</i>																				
<i>Inorganic</i>																				
<i>Organic</i>																				
BATTERIES, FUEL CELLS																				
PHOTOVOLTAICS																				
SENSORS																				
<i>Optical/light</i>																				
<i>Chemical/Biological/Pharma</i>																				
<i>Touch</i>																				
FASHION/WEARABLE ELECTRONICS																				

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(4) Component Manufacture and Supply																				
Substrates:																				
<i>Plastic</i>																				
Functional inks:																				
<i>Organic-based inks</i>																				
<i>Inorganic-based inks</i>																				
Active elements (e.g. display driving backplanes..)																				
Passive elements (e.g. antennas, light guides..)																				
Thin-film/printing/post processing manufacturing equipment and consumables																				
<i>R&D/lab scale</i>																				
<i>Prototype/manufacturing scale</i>																				
Display media (e.g. EP, OLED..)																				
Simulation and modelling packages																				
Discrete Si driver ICs																				
Back-end integration/flex foils/electronics packaging																				
Test and analysis equipment/service																				
Complete systems (in relatively low volumes/market sizes)																				
(5) Business Model and Financing																				
Funding:																				
<i>VC/angel funded (equity finance)</i>																				
<i>Private funding (bank, friends-and-family or own business revenues)</i>																				
<i>Majority Govt-funded/public sector entity</i>																				
<i>Involved with Govt grant funded projects (TSB Collaborative R&D, EU FP6/7 etc.)</i>																				
Current status:																				
<i>University - focus on Base Technology Research</i>																				
<i>University - Looking to also spin-out/technology transfer opportunities</i>																				
<i>Small start-up/SME</i>																				
<i>Larger corporate/international organisation/established company</i>																				
Main Business Model(s):																				
<i>Open access/Open innovation/Partnership working</i>																				
<i>Licensing business model (e.g. IP..)</i>																				
<i>Direct manufacture/supply to customers</i>																				
<i>Currently involved with JDAs/JVs</i>																				