

Coatema Inkjet printing

Overview

Introduction

Motivation

Inkjet printing

Inks

Printheads

Our status

Summary

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Inkjet printing

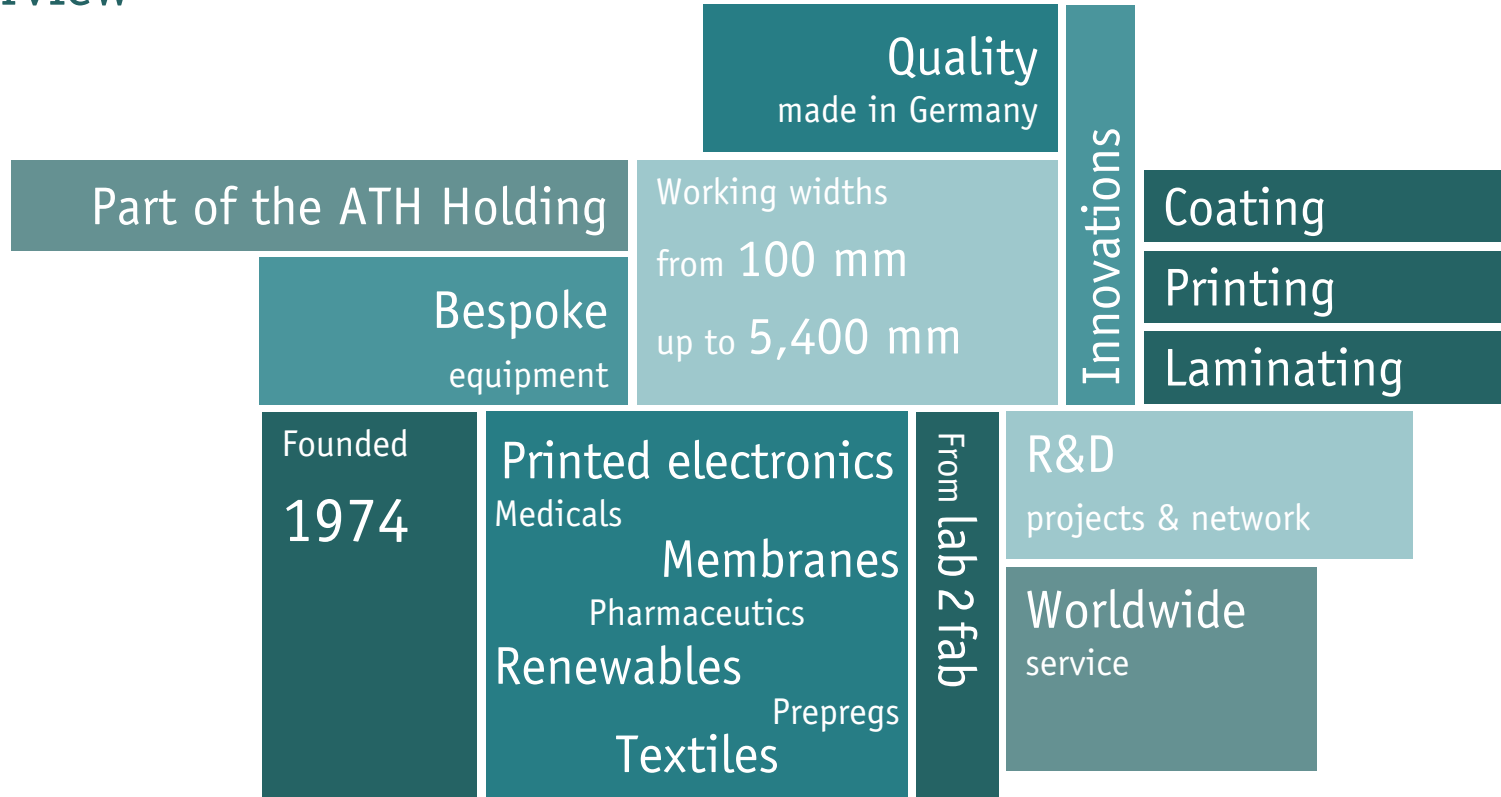
Inks

Printheads

Our status

Summary

Overview



Group of companies

ATH ALTONAER
TECHNOLOGIE
HOLDING



- ✓ Founded 1903
- ✓ Approx. 200 employees
- ✓ Located in Hamburg



- ✓ Founded 1995
- ✓ Approx. 50 employees
- ✓ Located in Norderstedt

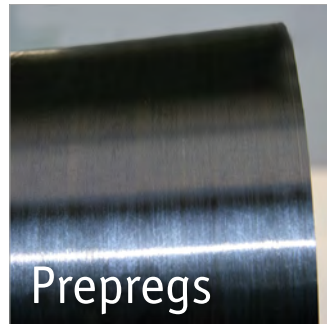
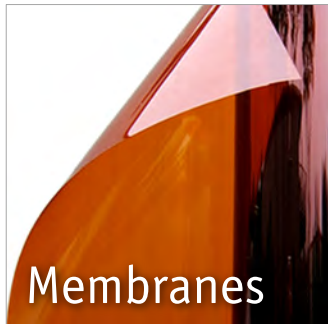
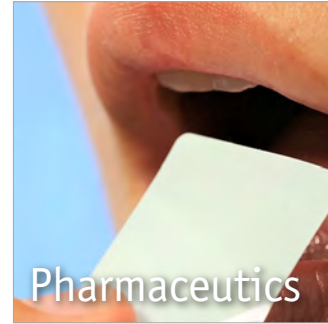
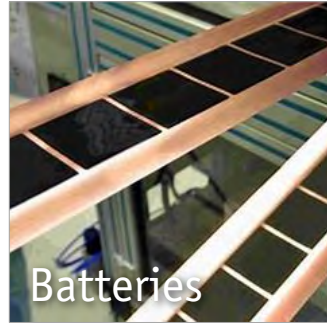
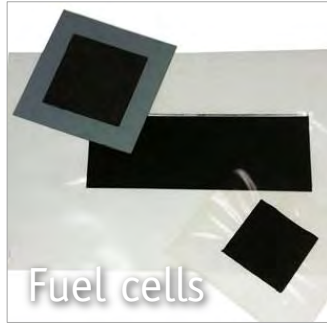


- ✓ Founded 1974
- ✓ Approx. 50 employees
- ✓ Located in Dormagen

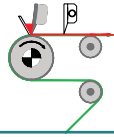


- ✓ Founded 1919
- ✓ Approx. 140 employees
- ✓ Located in Hamburg

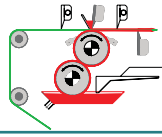
Our markets



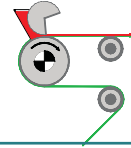
Coating systems



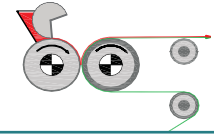
Knife system



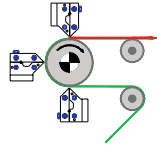
Double side system



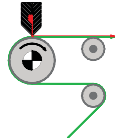
Commabar system



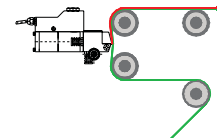
Reverse commabar system



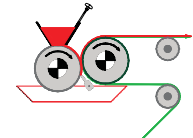
Slot die system



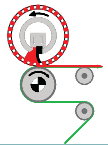
Curtain coating system



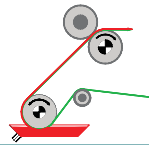
Hotmelt slot die system



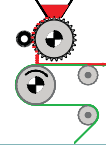
Case knife system



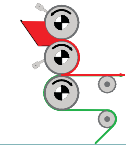
Rotary screen system



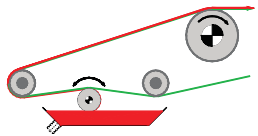
Dipping system (Fouard)



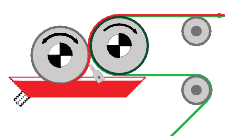
Powder scattering system



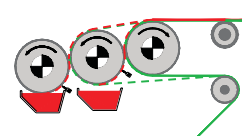
Reverse roll system



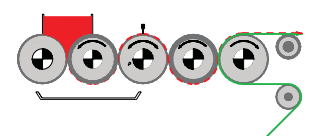
Micro roller system



2 Roller system

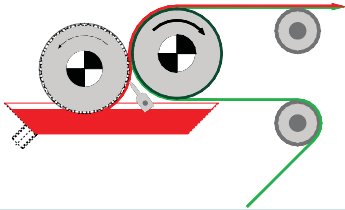


3 Roller combi system

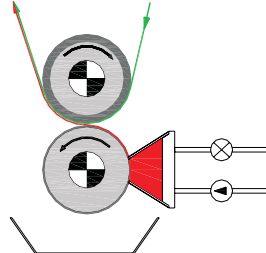


5 Roller system

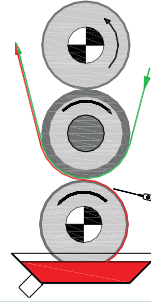
Printing systems



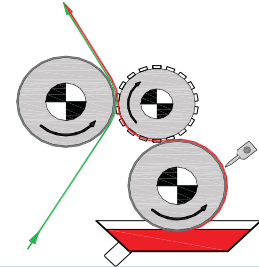
Engraved roller system



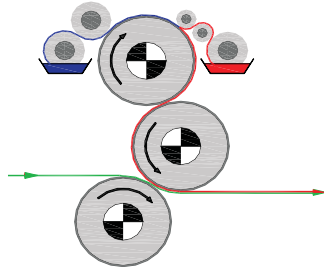
Gravure roller system



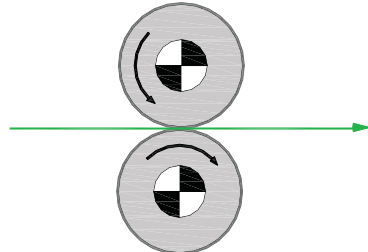
Gravure indirect system



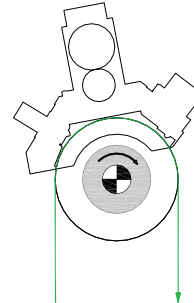
Flexography system



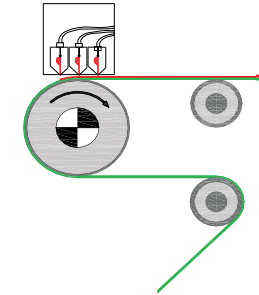
Offset lithography system



Hot embossing system



Nanoimprint system



Inkjet system

Our work in associations – global networking



Board Member:
OE-A

Advisory Board:
Fraunhofer ITA

Coatema customers



R&D customers



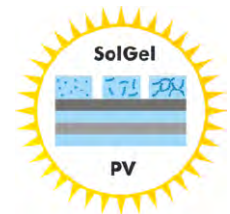
R&D projects overview 2020



Oled Solar



E-Nanoprint Pro



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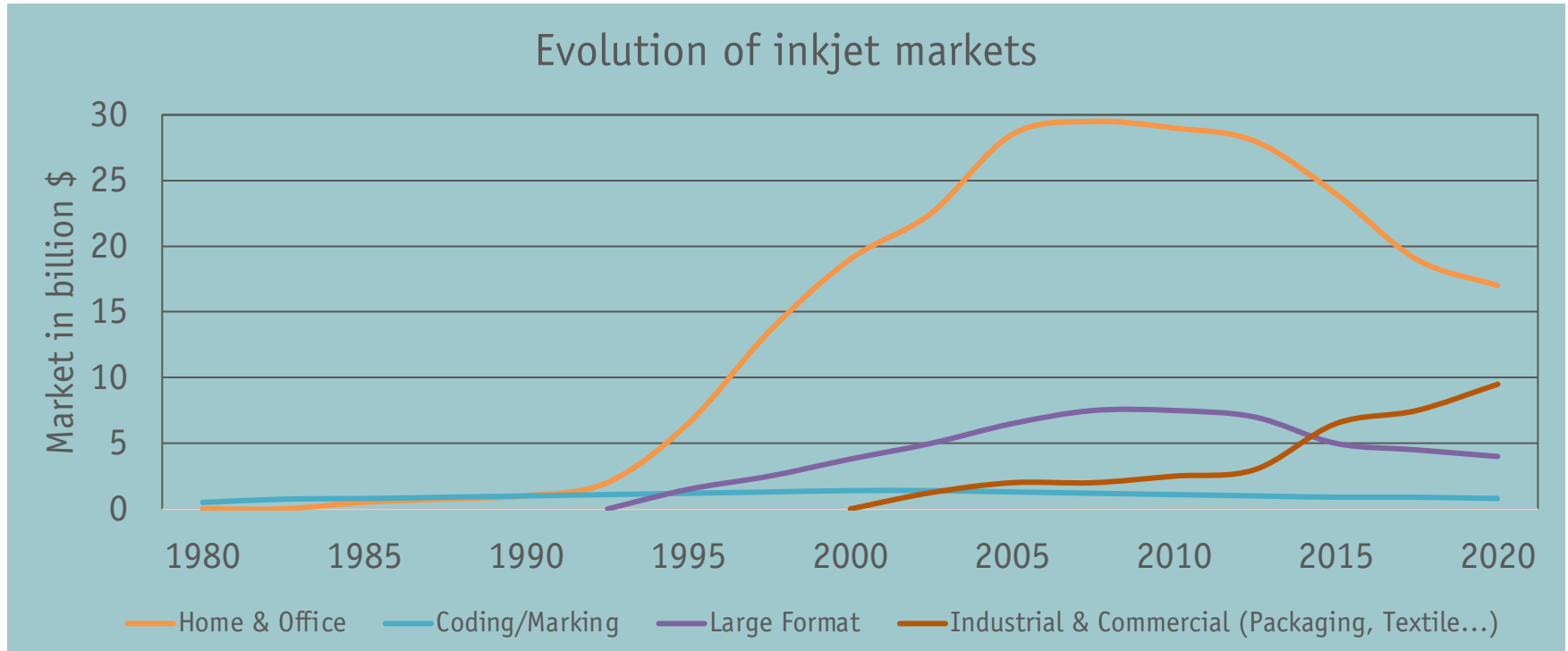
Definition of inkjet

- ✓ The inkjet technology is a contact free dot matrix printing procedure. Ink is issued from a small nozzle directly onto a specific position on a medium.
- ✓ Digital fabrication is an integrated approach to manufacturing that is centered around a computer system.

Advantages of inkjet

- ✓ Digital manufacturing – lot size 1
- ✓ Digital inkjet creates flexibility – digital fabrication
- ✓ Fast growing markets
- ✓ Inkjet technology continuously improves in:
 - ✓ Speed
 - ✓ Reliability
 - ✓ Fluid compatibility
 - ✓ Print quality

Increasing market



Understanding inkjet printing process

- ✓ Managing an ink through printhead engineering
 - ✓ Microfluidic properties along fine capillary channels
 - ✓ Maintaining ink properties at the meniscus
 - ✓ Formation of droplets
 - ✓ Consistent jet stability

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Inkjet printing

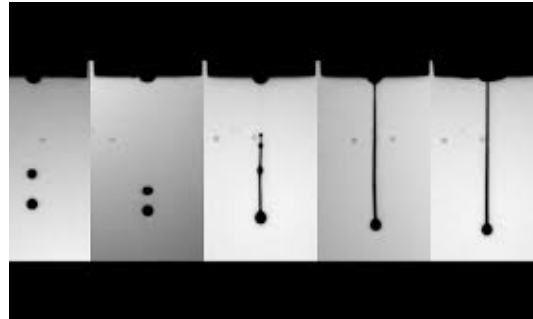
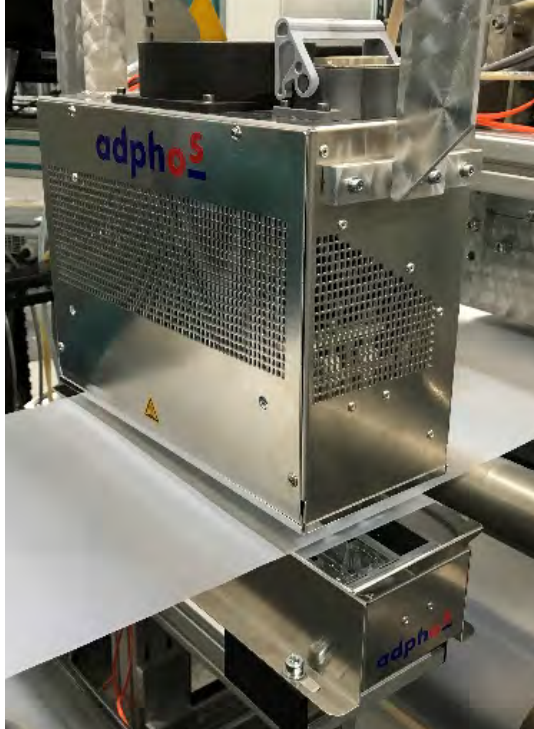
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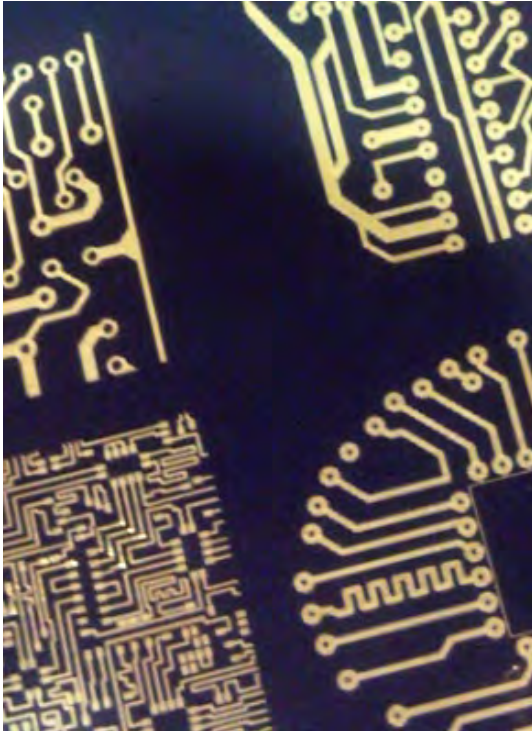
Aspects of inkjet printing



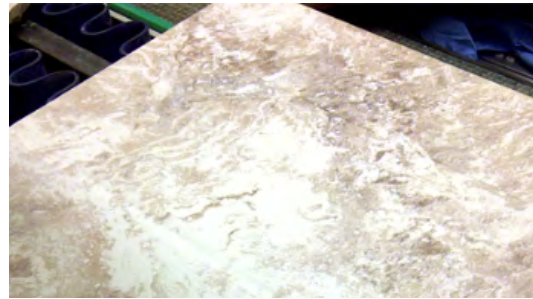
- ✓ Print head technique
- ✓ Ink details
- ✓ Inks positioning
- ✓ Drop watching
- ✓ Curing



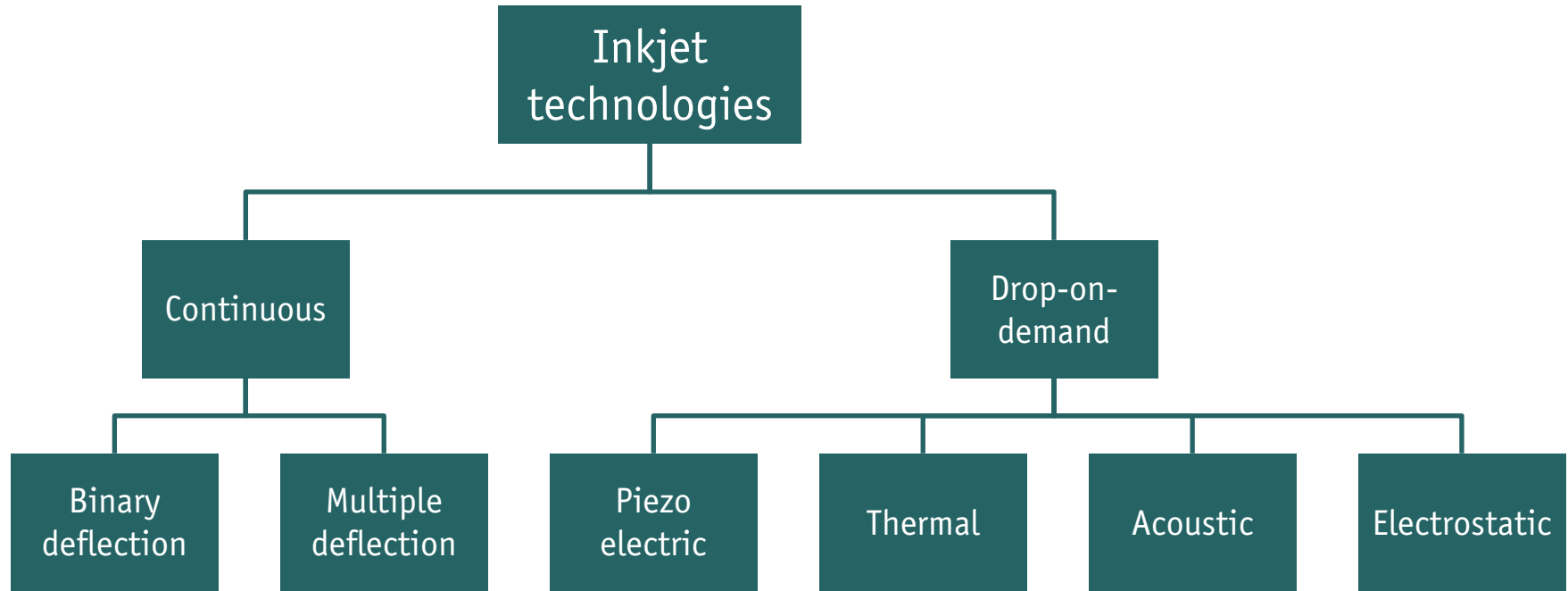
Applications



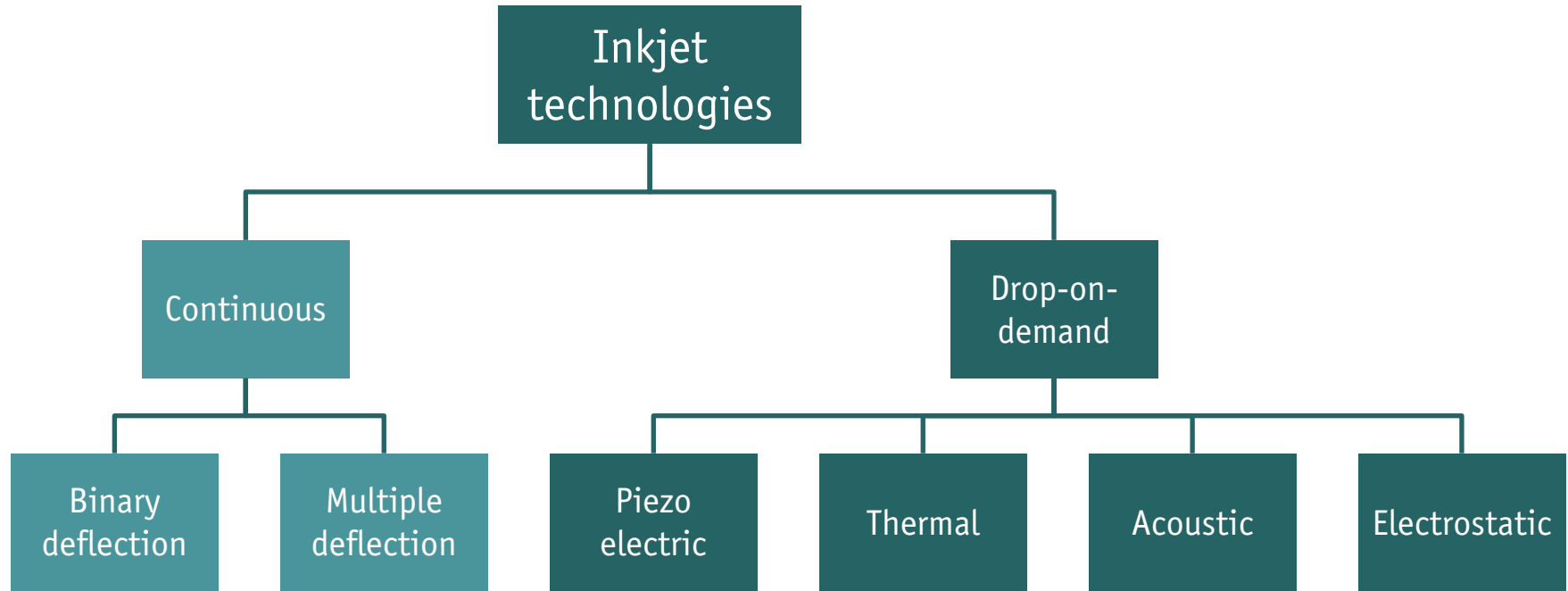
- ✓ Electronics
- ✓ Packaging
- ✓ Decoration
- ✓ Ceramic tiles
- ✓ Plastic cards



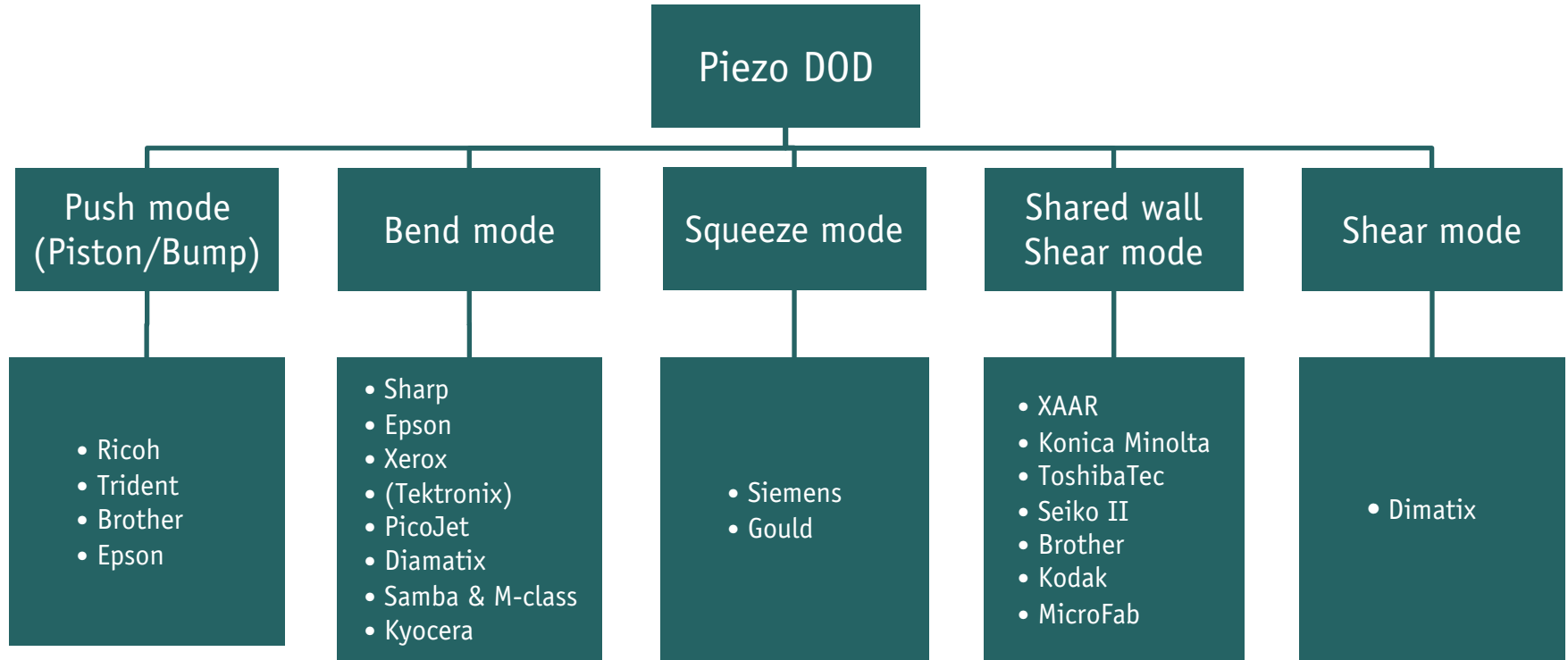
Different techniques



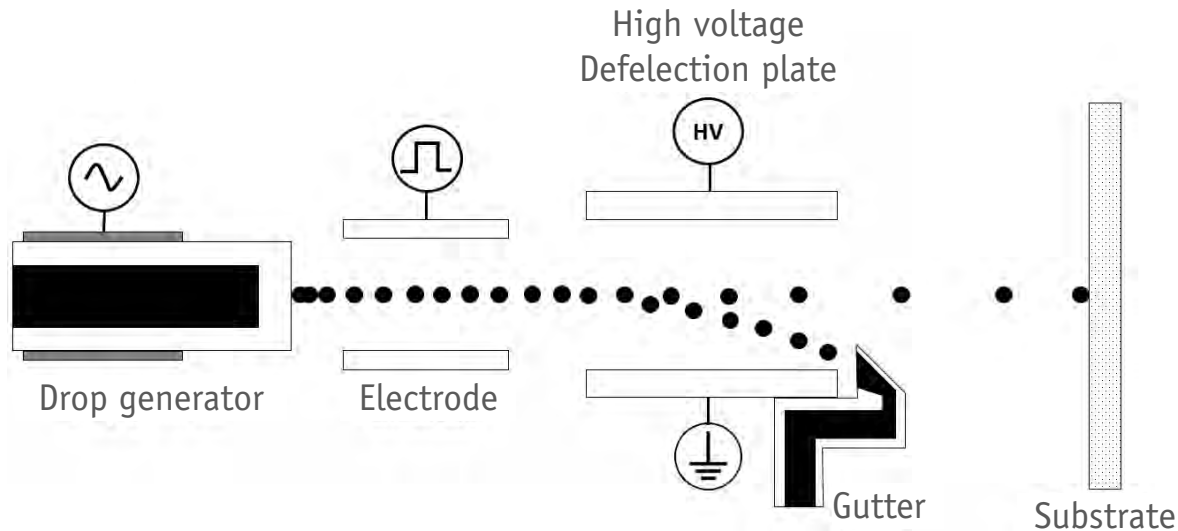
Different techniques



Inkjet on demand

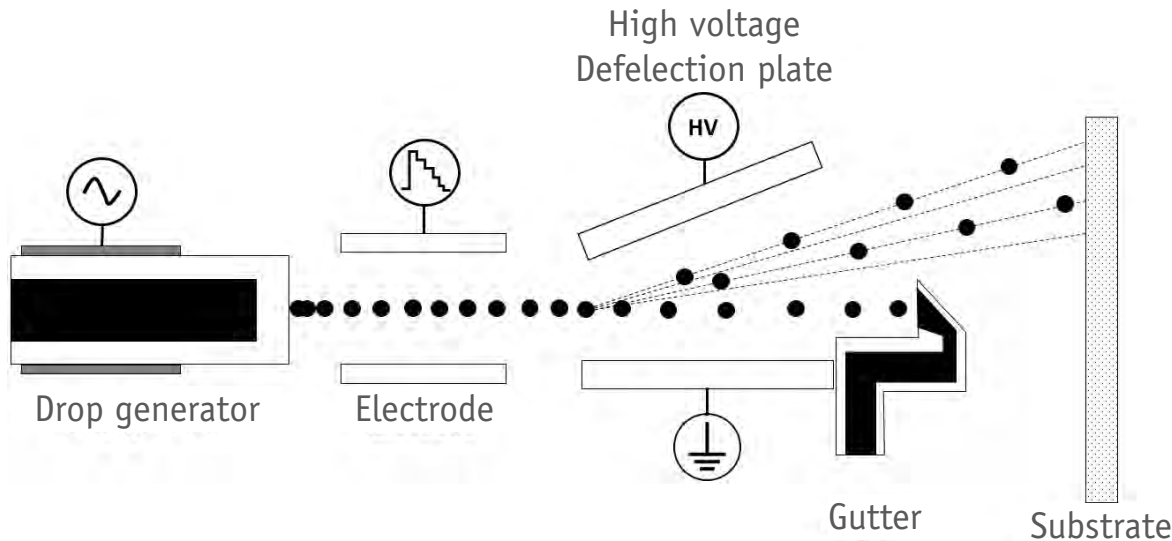


Binary continuous inkjet



- ✓ Generating drops by piezo ceramic actuators
- ✓ Unneeded droplets receive a charge in the electrode
- ✓ Charged drops are deflected, collected and recirculated by gutter

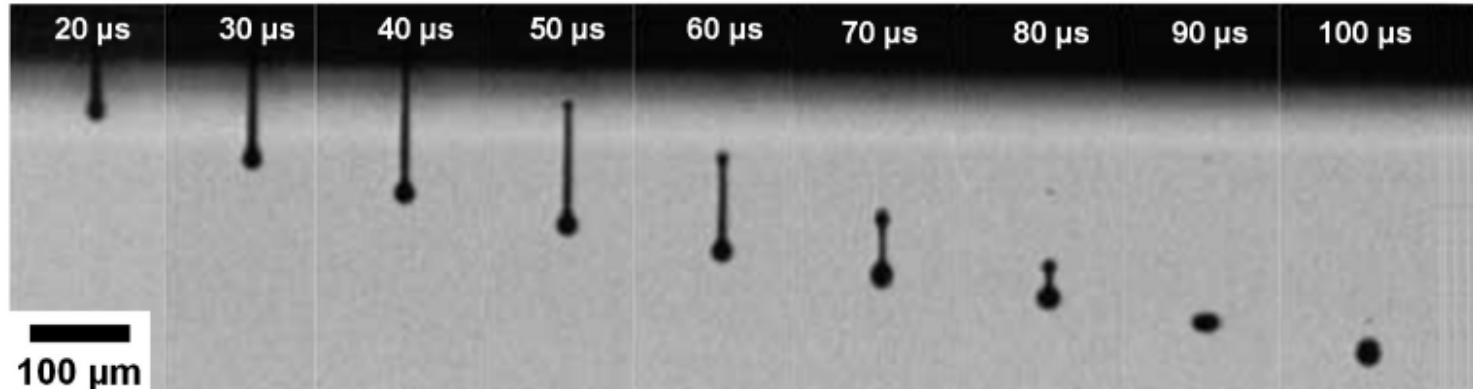
Multiple deflection



- ✓ Uncharged droplets recirculated by gutter
- ✓ Charged droplets deflected according to q/m (charge/mass) ratio
- ✓ 2-dimensional writing of small areas with single nozzle

Spezifikationen and requirements

- ✓ Surface tension 28 – 32 dynes/cm
- ✓ Rheology 2 – 30 mPas
- ✓ Drop volume down to 0.2 ml

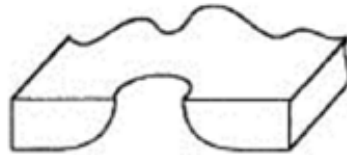


Drop formation cycle with 10 μ s intervals after application of the waveform to the piezoelectric transducer (inkjet printhead: Fujifilm Dimatix QS256, ink: ANP DGP 40LT-15C)

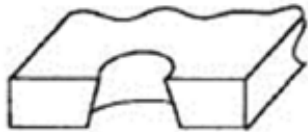
Nozzel design



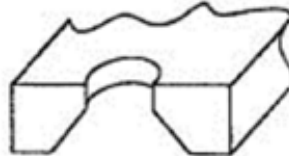
Cylindrical orifice
(Tektronix Sharp)



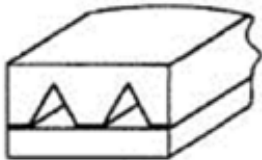
Convergent orifice
(HP, Dataproducts)



Tapered orifice
(Canon)



Tapered with
cylindrical exit orifice
(Seiko-Epson)



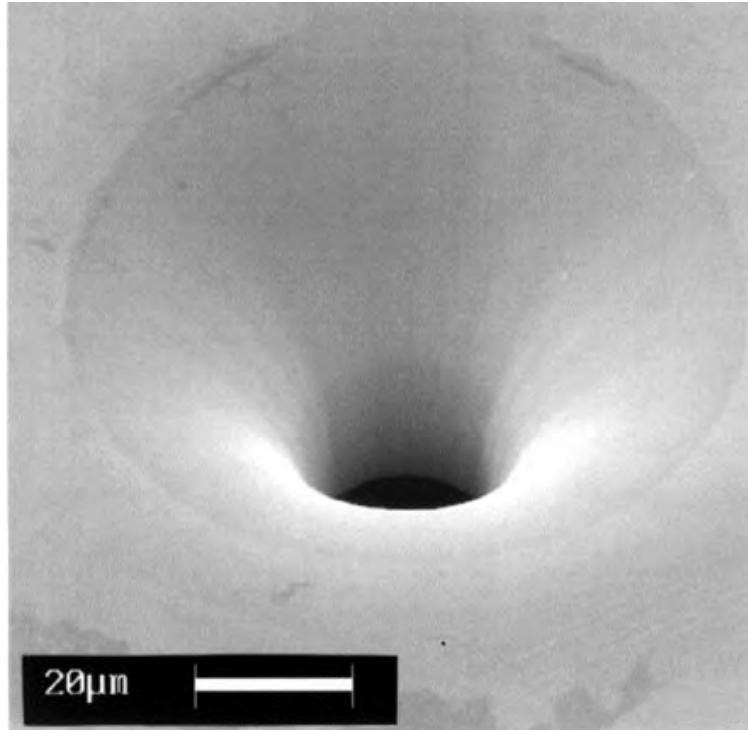
Triangle orifice
(Xerox)



Square orifice
(IBM)

- ✓ Geometry parameter of nozzle
- ✓ Effects on droplets
 - ✓ Volume
 - ✓ Speed
 - ✓ Deflection angle
- ✓ Effect on ink supply for refilling
 - ✓ Capillary forces
- ✓ Picture quality limited by fabrication tolerances

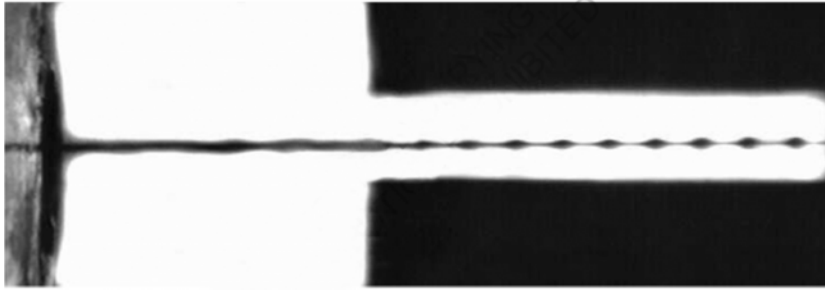
Nozzel design



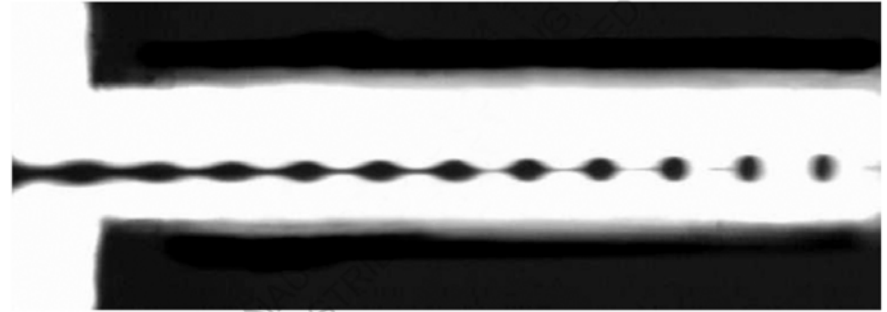
Electroplated
Ni-nozzle

- ✓ Geometry parameter of nozzle
- ✓ Effects on droplets
 - ✓ Volume
 - ✓ Speed
 - ✓ Deflection angle
- ✓ Effect on ink supply for refilling
 - ✓ Capillary forces
- ✓ Picture quality limited by fabrication tolerances

Droplet formation

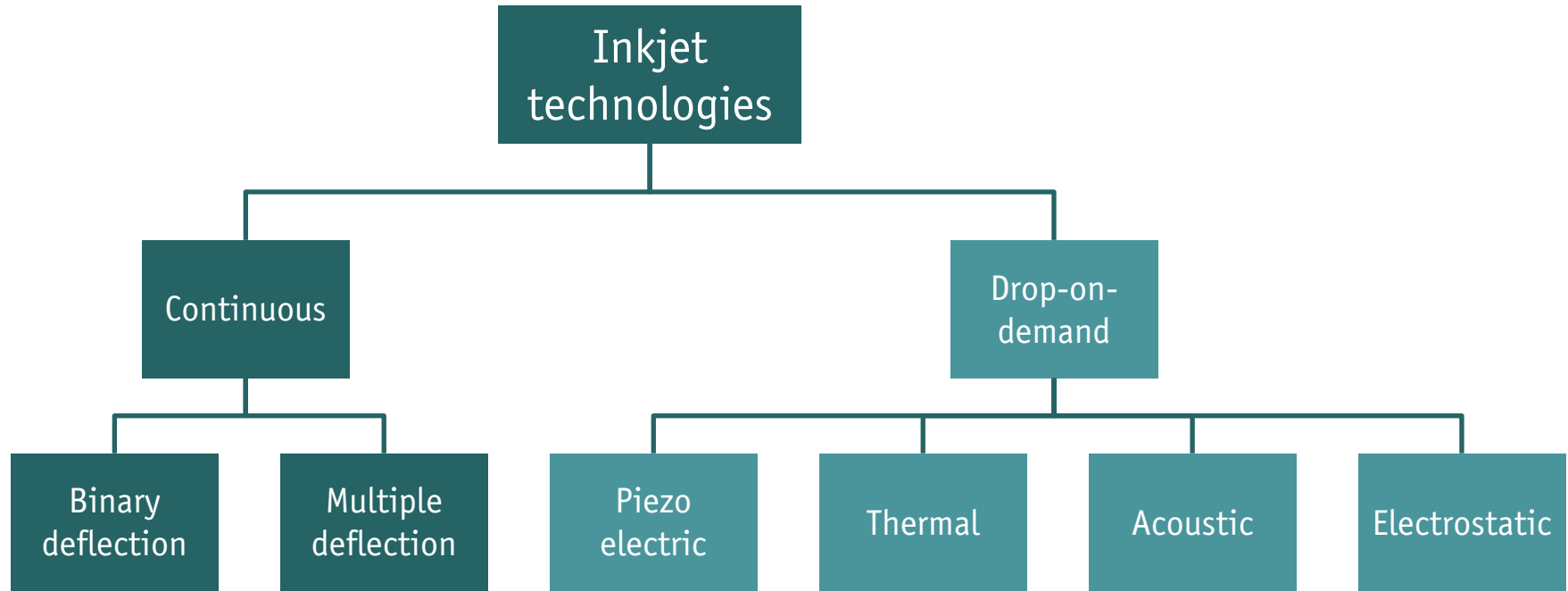


A continuous jet exiting the nozzle and travelling through the charge electrode

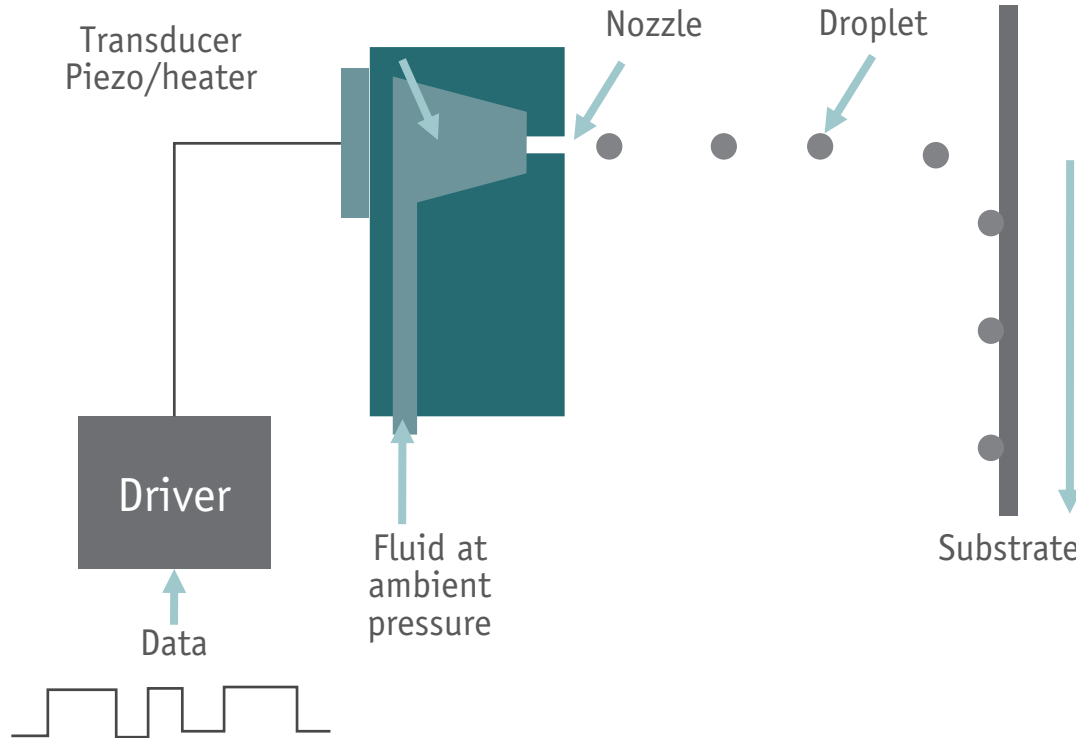


A continuous jet showing tails – the start of erratic ligament formation

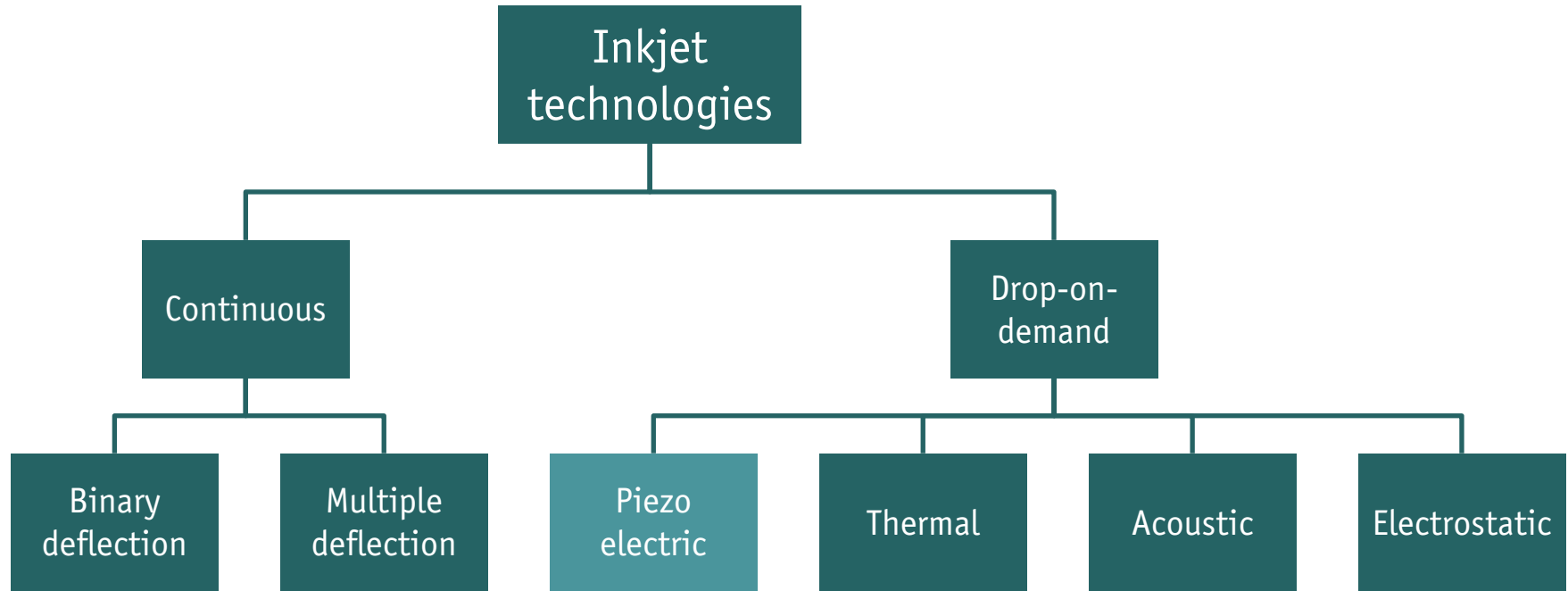
Different techniques



Drop on demand technique



Different techniques

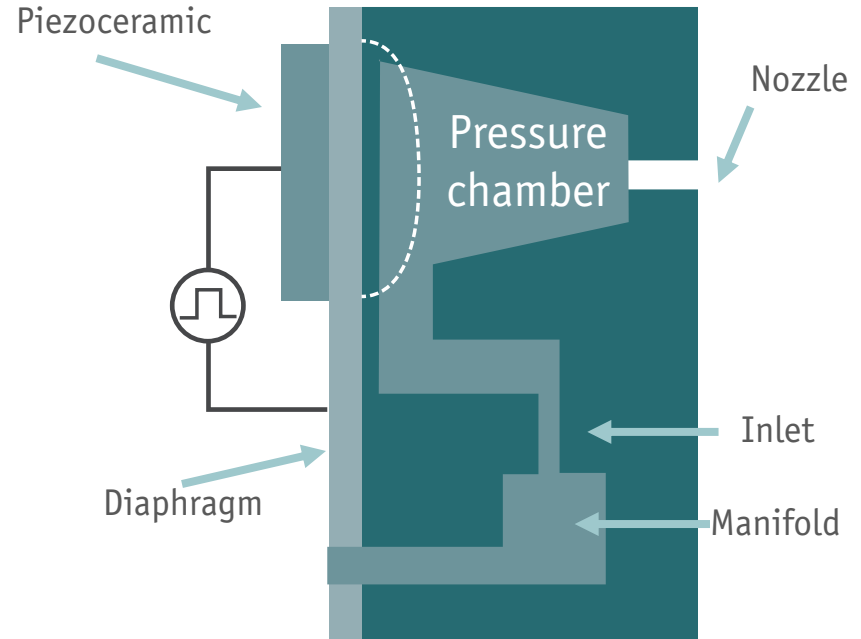


Working function piezo head

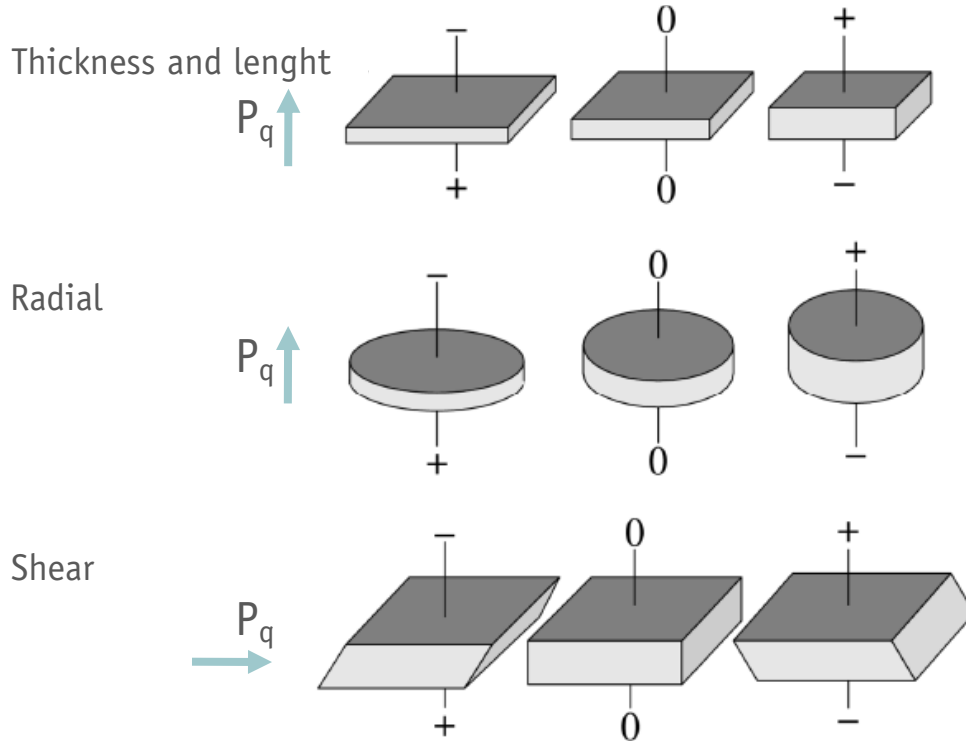
- ✓ Impulse method by deformation of piezo ceramic
- ✓ Change in pressure chamber volume
- ✓ Pressure wave propagates to nozzle

Problem: miniaturization

- ✓ Piezo element has to be much larger than the nozzle
- ✓ Deflection of the piezo less than 1 μm



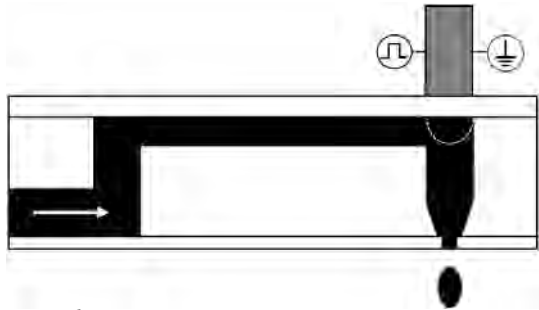
Different deformation for piezo elements



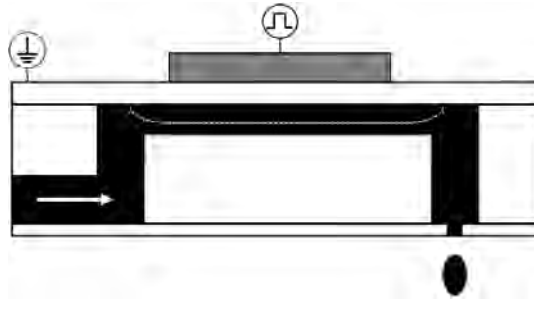
- ✓ Piezo ceramic is extended by applying voltage
- ✓ Different movement due to polarization of the ceramic

Piezo inkjet modes

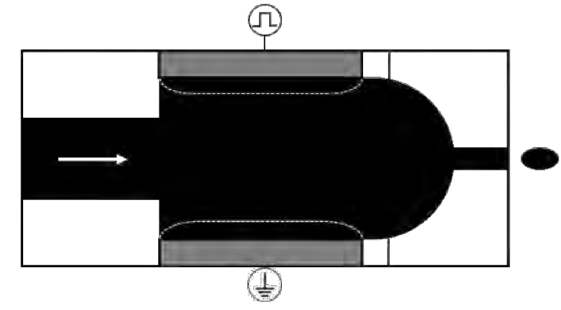
✓ Different techniques for drop generation



Push



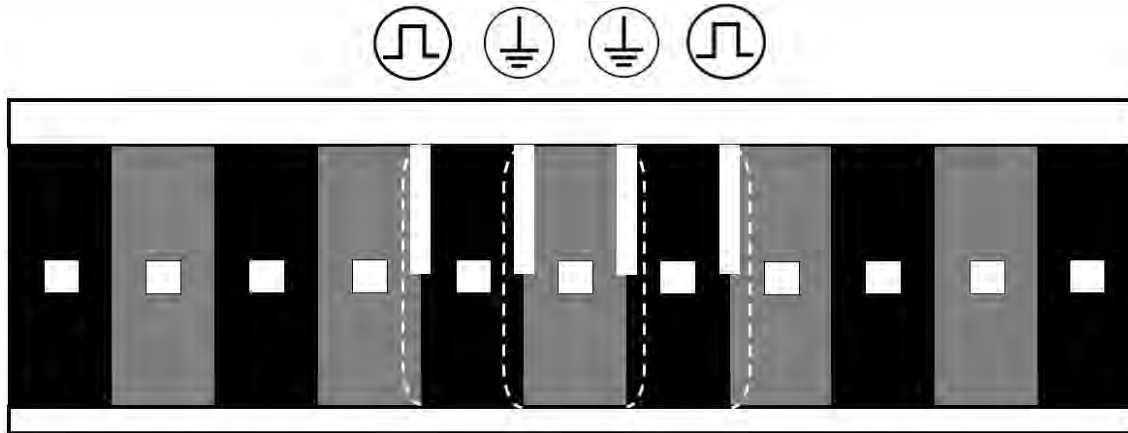
Bend



Squeeze

Diagrams source: Herman Wijshoff, Structure and fluid-dynamics in piezo inkjet printheads, (2008)

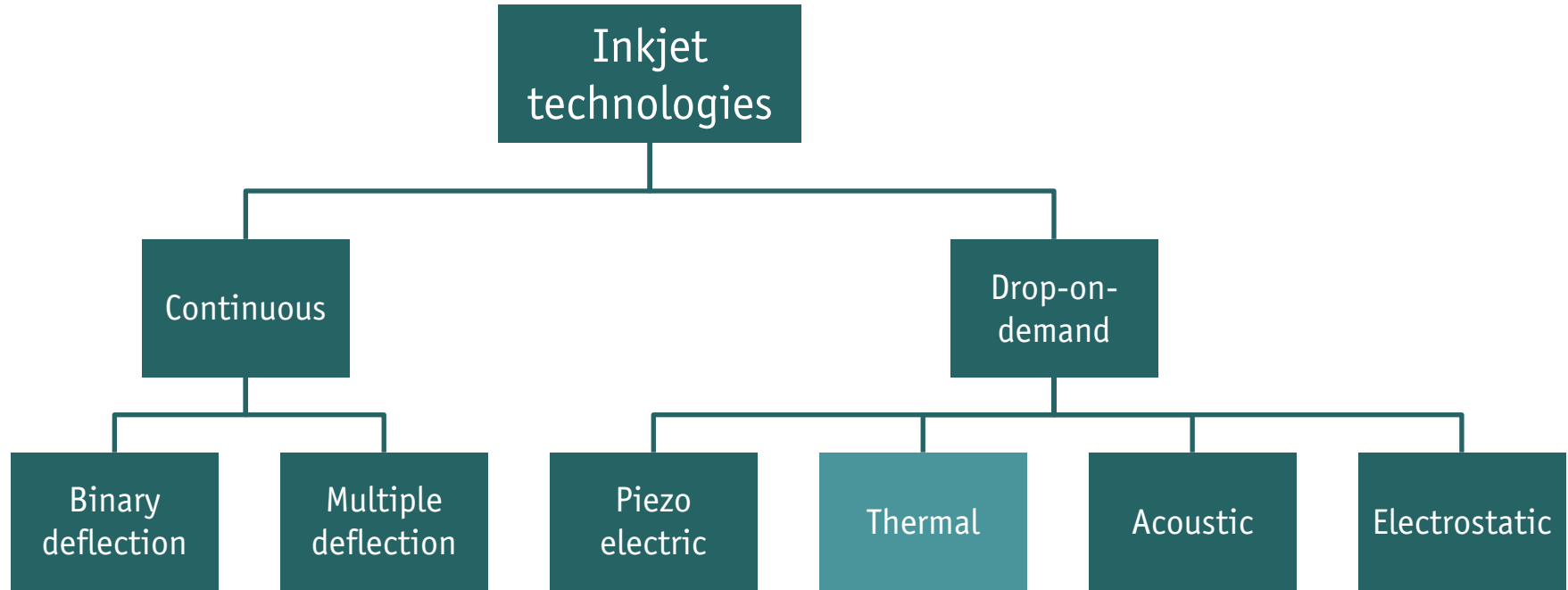
Piezo inkjet modes – shear



- ✓ Piezoceramics as active wall in direct touch with ink
- ✓ Shear-motion generates droplet

Diagrams source: Herman Wijshoff, Structure and fluid-dynamics in piezo inkjet printheads, (2008)

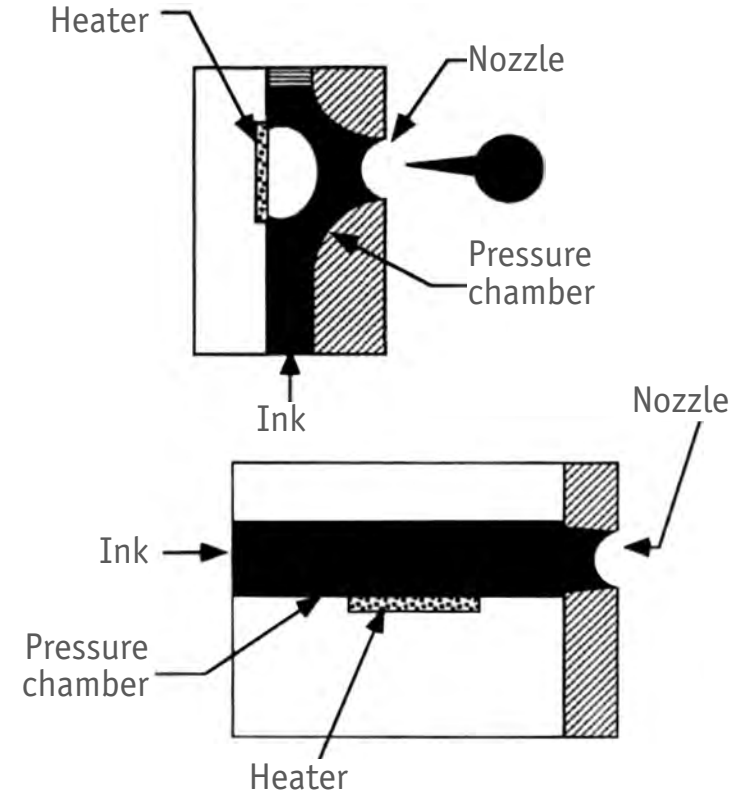
Different techniques



Thermal inkjets

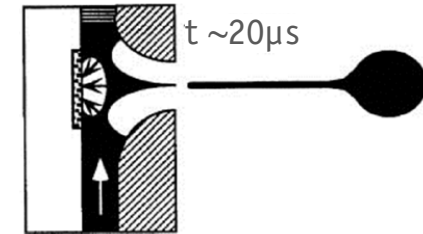
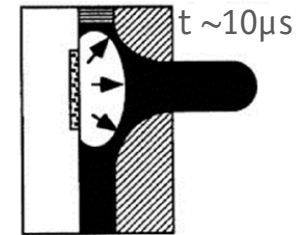
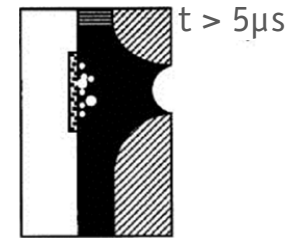
Commercially most successful

1. Roof shooter
✓ Heater above orifice
1. Side-Shooter
✓ Heater lateral to orifice



Phases of droplet formation

1. Heating for some μs
 - ✓ Overheated ink
 - ✓ At 300°C: nucleation of bubble
2. Expansion
 - ✓ Ejection of ink
 - ✓ Parallel to bubble expansion
3. Droplet formation
 - ✓ Collapsing vapor bubble
 - ✓ Retracting of bulk ink
 - ✓ Refilling of cavix (80 – 200 μs)
 - ✓ Speed-critical step

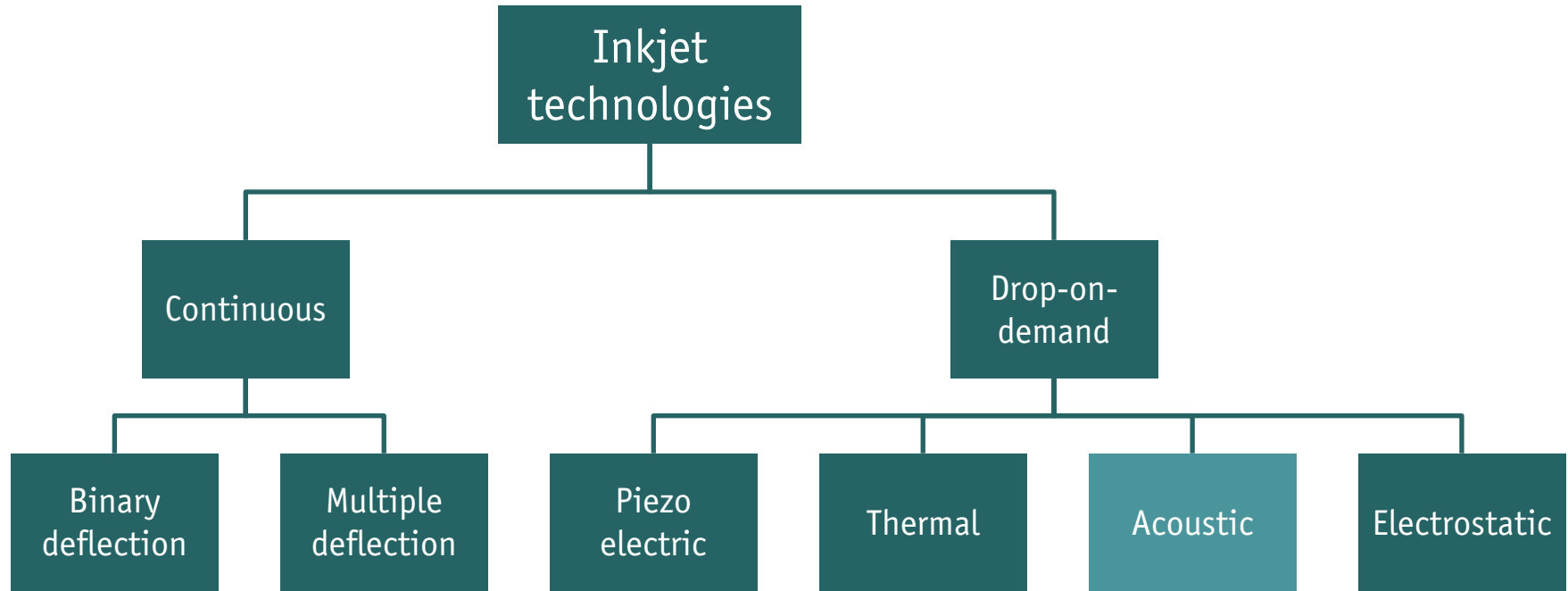


Summary thermal inkjet

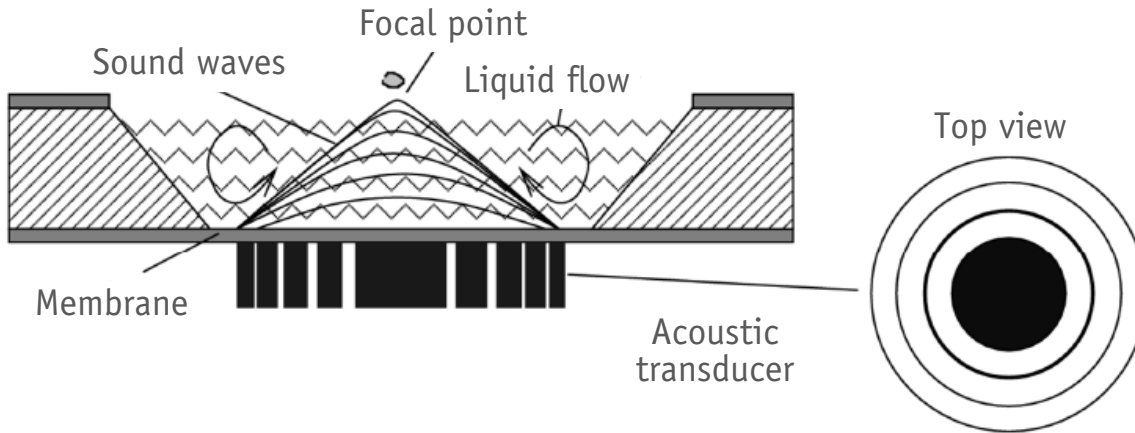
- ✓ Advantages
 - ✓ Low product cost
 - ✓ Large development and production investment
 - ✓ High nozzle density
- ✓ Disadvantages
 - ✓ Restricted ink types
 - ✓ Low duty cycles



Different techniques

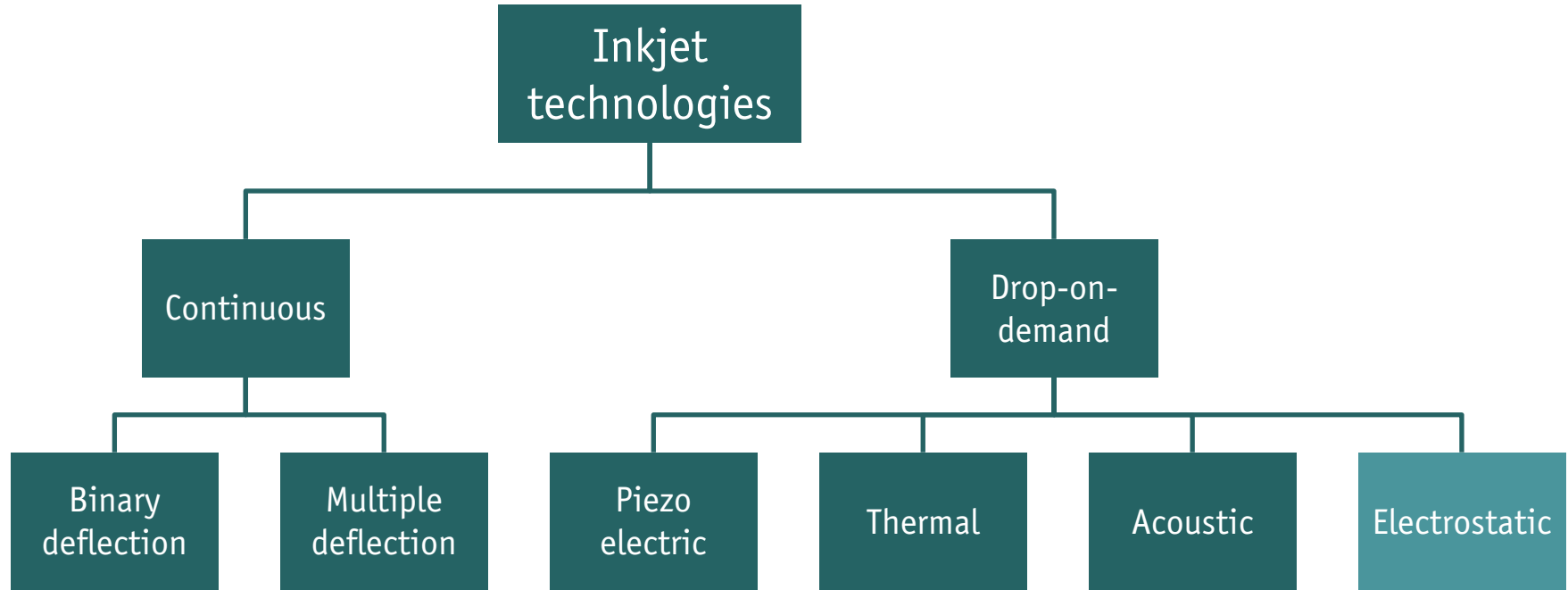


Ultrasonic droplet generation

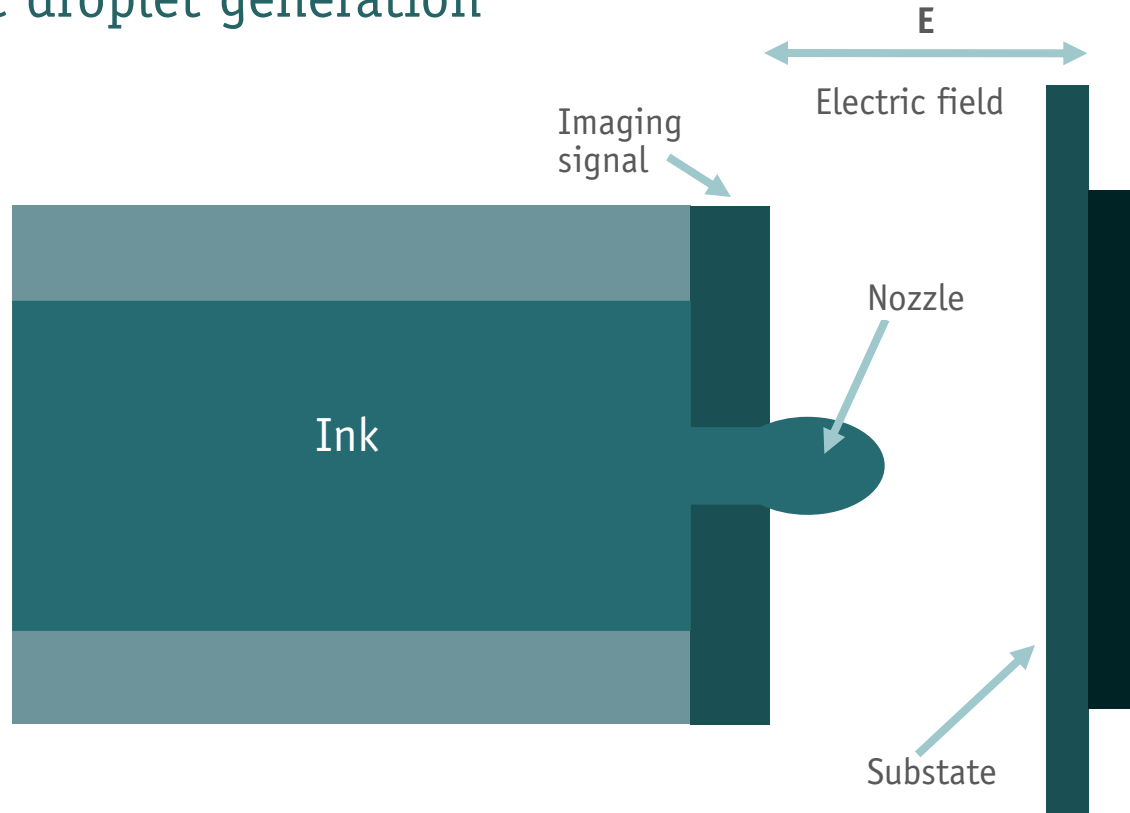


- ✓ Acoustic transducer
- ✓ Constructive interference of waves
- ✓ Similar to Fresnel lens

Different techniques



Electrostatic droplet generation



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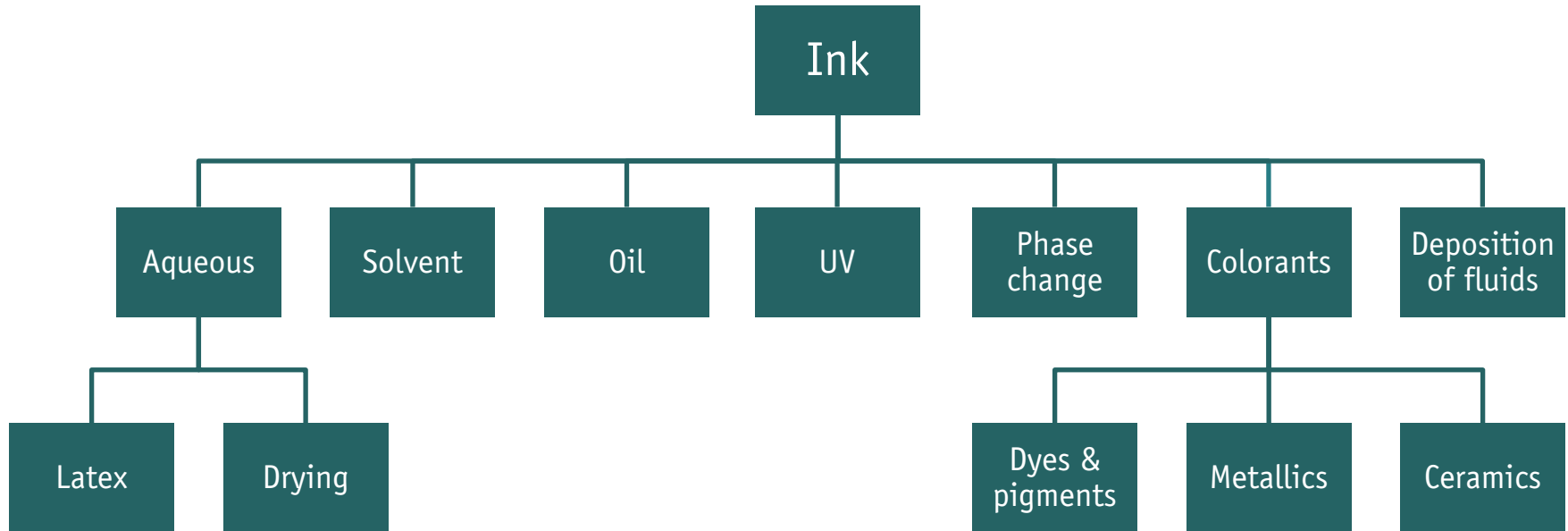
Printheads

Our status

Summary

INKS

Ink basis



Colorants

- ✓ Over 10 000 generic name colorants are listed
- ✓ Over 4 500 are commercially available
- ✓ Only a small handful are suitable for inkjet use
 - ✓ Solubility / Dispersibility
 - ✓ Rheology
 - ✓ Purity
 - ✓ Temperature shock resistance (for thermal inkjet)
 - ✓ Light air stability

Pigments

Dyes

Acid

Direct

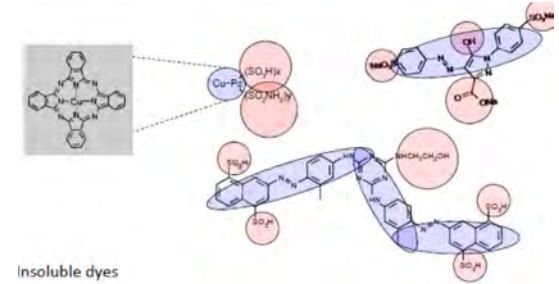
Modified
direct

Reactive

Disperse

Pigments

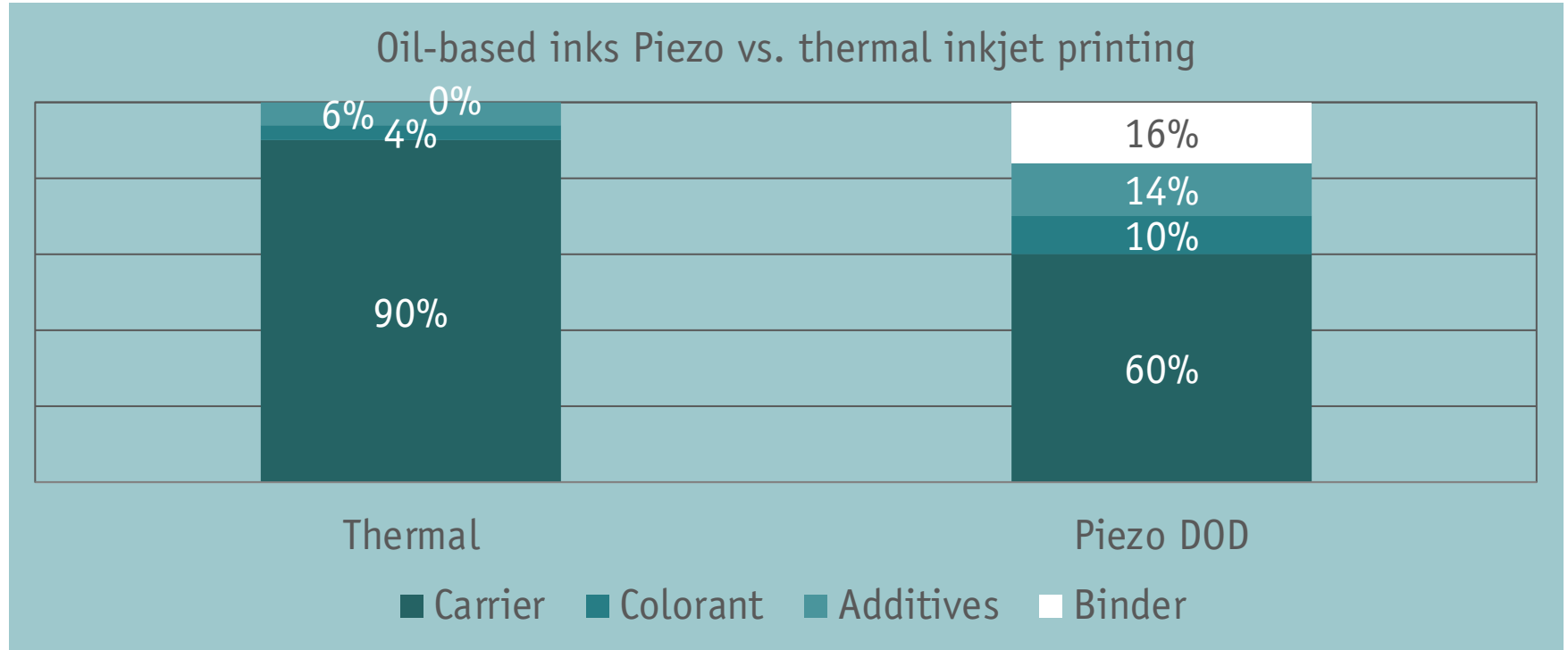
- ✓ Insoluble dyes
- ✓ Conjugated molecules are rigid insoluble
- ✓ More lightfast
- ✓ More waterfast due to need for resins to bind to substrate
- ✓ Pigments are much smaller than nozzles
- ✓ Problems:
 - ✓ Maintaing dispersion
 - ✓ Achieving stable drop break-off
 - ✓ Nozzle maintance
 - ✓ Drying speed vs. Robustnetts
- ✓ White inks usually based on TiO₂, must be circulated to stay in suspension



Oil-based inks

- ✓ Used for some porous substrate applications
 - ✓ Coding & marking
 - ✓ High-speed printing
 - ✓ Ceramic tiles
- ✓ Material used
 - ✓ Long chain glycols and hydrocarbons, vegetable oils
- ✓ Piezo printheads only – no volatile component for thermal Inkjet
- ✓ Fast drying
 - ✓ Drops absorb very quickly into substrate

Oil-based inks



Different types of ink formulations for DOD

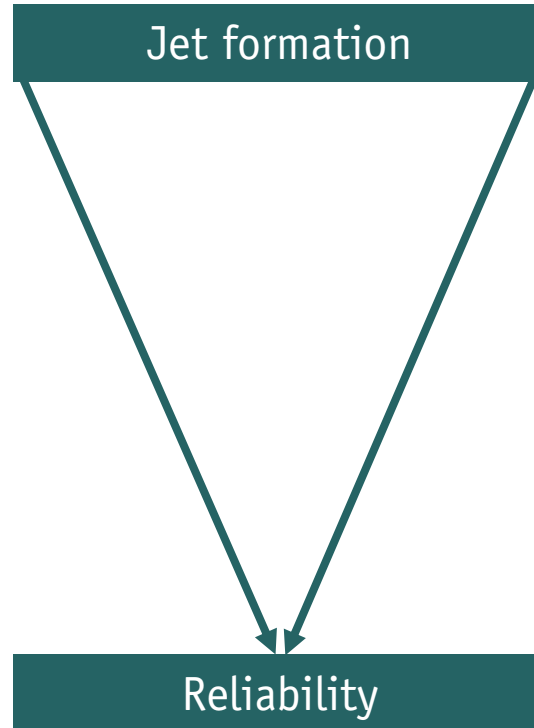
- ✓ Solvent-based inkjet inks
 - ✓ Traditionally, industrial systems have used non drying glycols for porous media
 - ✓ Trend towards solvent based systems for faster drying on non porous media (like wide-format vinyls)
- ✓ Water-based inkjet inks
 - ✓ Predominantly used in office based systems, e.g. Epson
 - ✓ Limited use in shared wall technology due to need to passivate heads
 - ✓ New developments focused on non porous media applications
- ✓ Oil-based inks
 - ✓ Used in shared wall and industrial systems
 - ✓ Suitable for porous media only

New type of inks

- ✓ Phase change inkjet inks
 - ✓ Clean and environmentally the best inkjet technique
 - ✓ Control of print quality on porous and non porous media is excellent
 - ✓ Extremely poor adhesion and durability has limited growth
 - ✓ New chemistry provides renewed lease of life for industrial systems
 - ✓ Important niche system for desk top systems
- ✓ UV curable inkjet inks
 - ✓ Some commercial uv-curable inks for industrial system appearing
 - ✓ Important patent restrict use of some key materials
 - ✓ Opportunity for non porous media, e.g. wide-format vinyls

Aspects of ink design

- ✓ Compatibility
- ✓ Nozzle design
- ✓ Chemical ageing
- ✓ Polymer & dye interaction
- ✓ High shear rheology



- ✓ Chemical structure
- ✓ Molecular weight
- ✓ Viscoelasticity
- ✓ Interfacial energy
- ✓ Exit contact angle

Deposition of different inks

- ✓ Ink must have good jetting properties and have functionality
- ✓ Starting point are normally existing functional fluids
 - ✓ Problem is getting enough material into a jettable fluid
- ✓ Jones' first law of ink jet inks: An ink's functionality is inversely proportional to its jetting performance
 - ✓ i.e. anything that jets well will be useless in the process and vice versa
- ✓ For most applications, jetting performance must be very high
 - ✓ Small drop sizes
 - ✓ High placement accuracy
 - ✓ No satellites
- ✓ Development enhanced by seeing what you're doing → Drop watcher etc.

Aqueous-based inks

- ✓ Dominate markets with porous substrates
 - ✓ Desk-top printing
 - ✓ Mailing & addressing
 - ✓ Commercial printing
 - ✓ Textile printing
- ✓ Glycols added to reduce drying in nozzles
- ✓ Intercolour bleed on substrate needs controlling
- ✓ Balance between control of drop spread and drying speed

Solvent-based inks

- ✓ Traditionally used for applications with non-porous substrates
- ✓ Typical solvent used
 - ✓ Alcohols, MEK, glycols, lactates
- ✓ Balance between nozzle open time and drying speed
- ✓ Odour issue, image can take hours to lose odour
- ✓ Shipping & storage issue for volatile / Inflammable materials

UV-curable inks

- ✓ High image quality and durable images on non-porous substrates
- ✓ Options:
 - ✓ Free radical – high speed cure, shrinkage problems
 - ✓ Curing stops when exposure to UV lights ends
 - ✓ Oxygen inhibits cure, so nitrogen purging used
 - ✓ Can be diluted with solvent / water for thermal inkjet
 - ✓ Cationic – slower cure, good adhesion with no shrinkage
 - ✓ Curing continues post-curing
- ✓ Expensive materials from limited sources

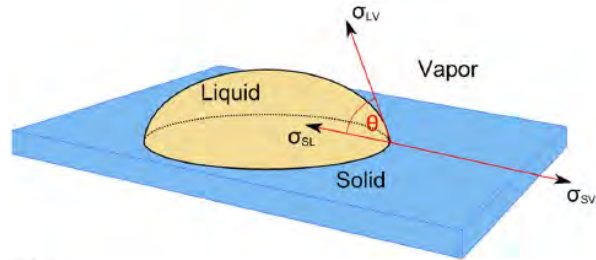
Inks specifications

Manufacturer	Ink	Solids content (wt%)	Particle size (nm)	Viscosity tension (mPas)	Surface tension (mN/m)	Solvents	Costs (€/ml) or (€/g)*
Advanced Nano Product	ANP DGP 40LT-15C	30 – 35	≤ 50	10 – 17	35 – 38	Triethylene glycol monoethyl ether	7.5
Bando	OJ30-1	1 – 40	15 – 20	5 – 15	20 – 40	1,3-propanediol, glycol, glycerin, water	45
Bando	OJ31-1	35 – 45	15 – 20	6 – 10	25 – 30	Glycol, glycerin, water	45
Bayer	Bayink TPS C	~ 20	Not available	~ 10.6	~ 23.3	Water	11
Cabot	CSD-32	45 – 55	< 60	50 – 100		Ethylene glycol	6.5*
Fraunhofer IKTS	Ag-LT-20	~ 20	< 80	8 – 12	32 – 38	Water	16.5
Genes'Ink	CS01121	20	< 10	10 – 16	24 – 30	Alkane, alkohol	10
Harima	NPS-JL	~ 55	~7	~ 11	Not available	N-Tetradecane, petroleum hydrocarbon, napthen	6.6*
KS Hisense	Jet-600C	10 – 30	Not available	7 – 10	27 – 29	Alcohol	2.6*
Methode	9102	–	–	~ 3.5	31 – 33	Water	9.1
Novacentrix	Metalon JS-B25HV	~ 25	~ 60	~ 8	30 – 32	Water	3.7
PVnanocell	I125EGE-100	20 – 30	70 – 115	Not available	Not available	Ethylene glycol, ethyl alcohol	5.3
PVnanocell	I125EGD-101	20 – 30	70 – 115	Not available	Not available	Ethylene glycol, dipropylene glycol, methyl ether	5.3
PVnanocell	I30EG-1	~ 30	70 – 115	~ 28	~ 47	Ethylene glycol	5.3
PVnanocell	I30TD-102	28 – 32	70 – 115	Not available	Not available	Tripropylene glycol, methyl ether, dipropylene glycol	5.3
PVnanocell	I50T-11	48 – 50	70 – 115	– 24	– 28	Tripropylene glycol monomethyl ether	5.3
Sun Chemical	Suntronic EMD5603	~ 20	30 – 50	7 – 14	27 – 31	Ethanediol, ethanol	7
Sun Chemical	Suntronic EMD5703	~ 40	Not available	10 – 13	27 – 31	Ethanediol, ethyl (S) -2-hydroxypropionate	20.9
UTDots	UTDAgIJ1	55 – 60	~ 10	5 – 30	Not available	Hydrocarbons	12.7
Xerox	XCM-NS32	~ 32	< 12	~ 3	Not available	Decahydronaphthalene	6.2*

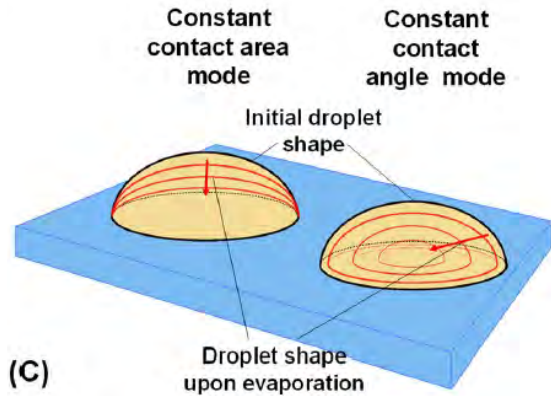
Requirements

Inkjet type	Frequency range [kHz]	Viscosity range [cP]	Ink type	Drop size [pl]
Continuous	50 – 500	3 – 6	Aqueous, solvent	2 – 6
Low definition Piezo-based	4 – 10	2 – 6	Aqueous, eco/bio, solvent	2 – 6
High definition Piezo-based	4,8 – 60	6 – 30	Aqueous, oil, phase change, eco/bio, solvent	3 – 90
Thermal	1.5 – 50	2 – 5	Aqueous, UV	1 – 220

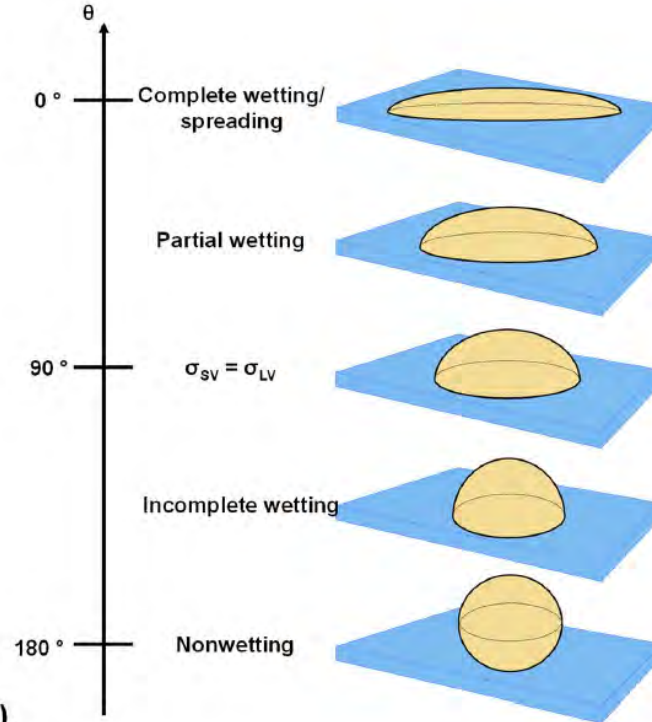
Impact surface tension



(A)

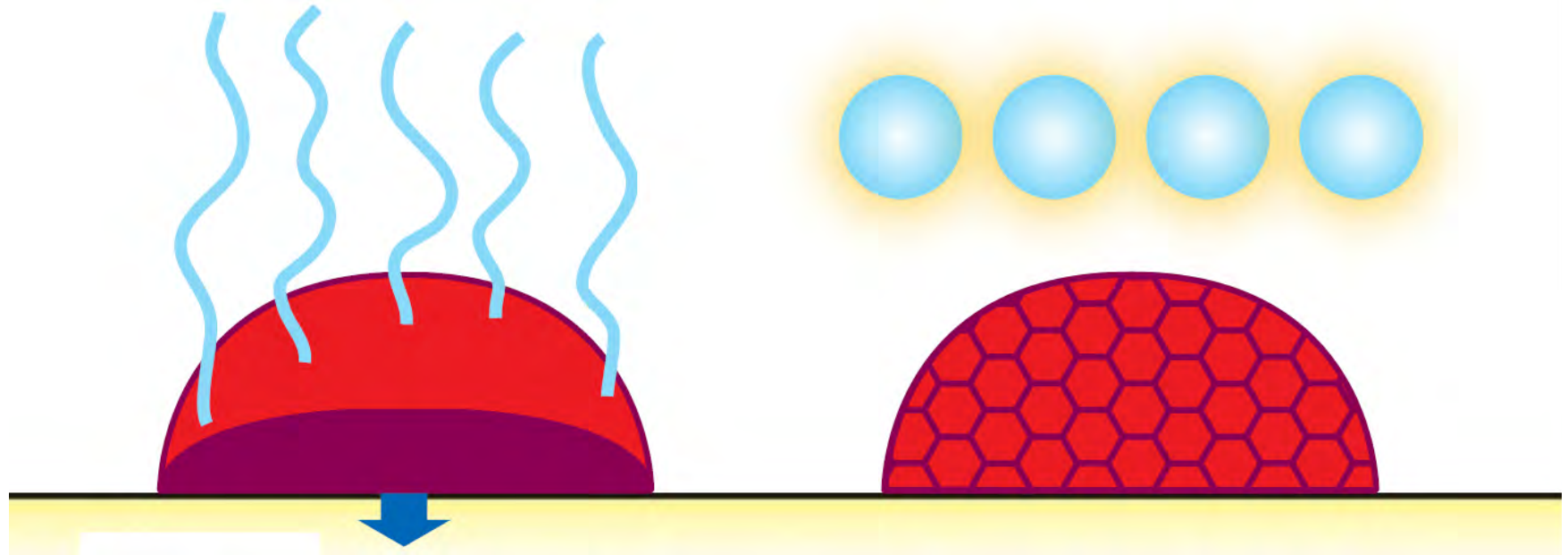


(C)



(B)

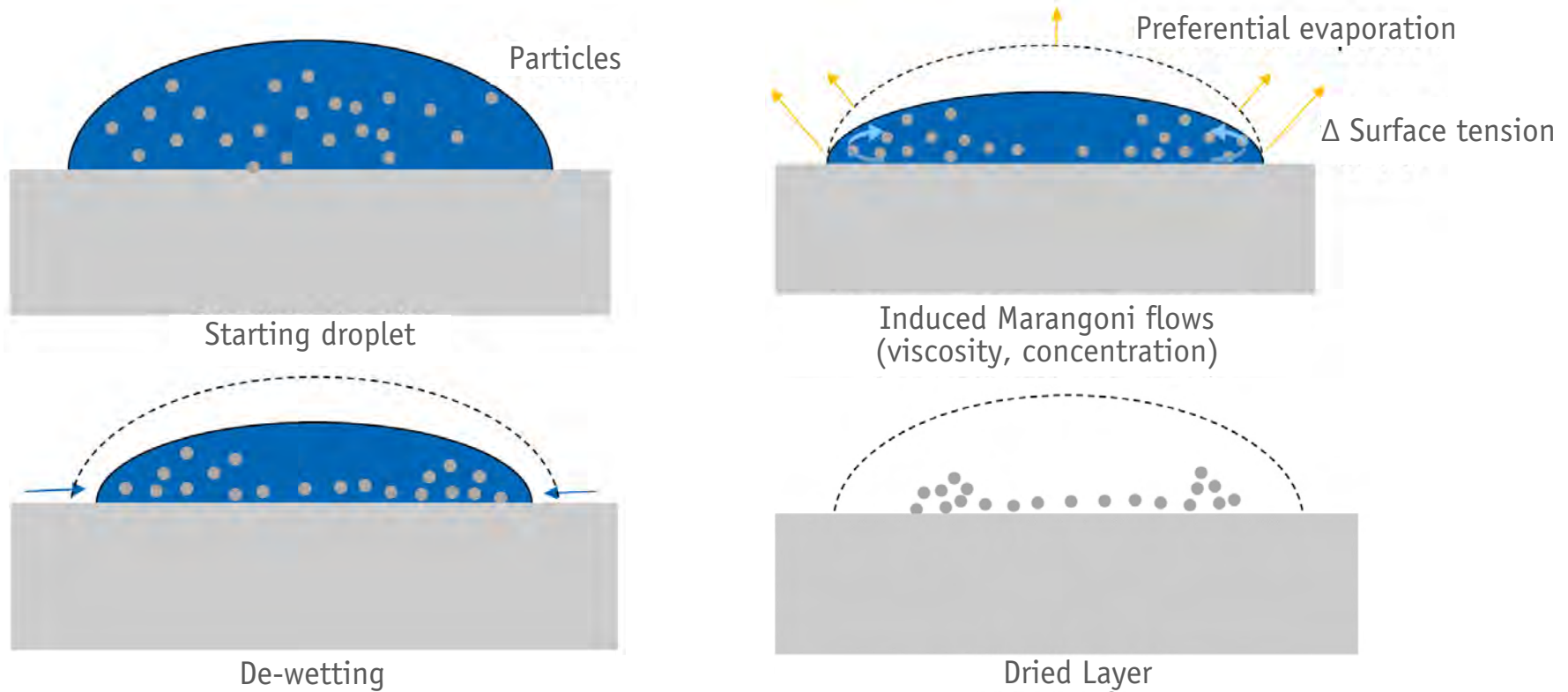
Drying & curing



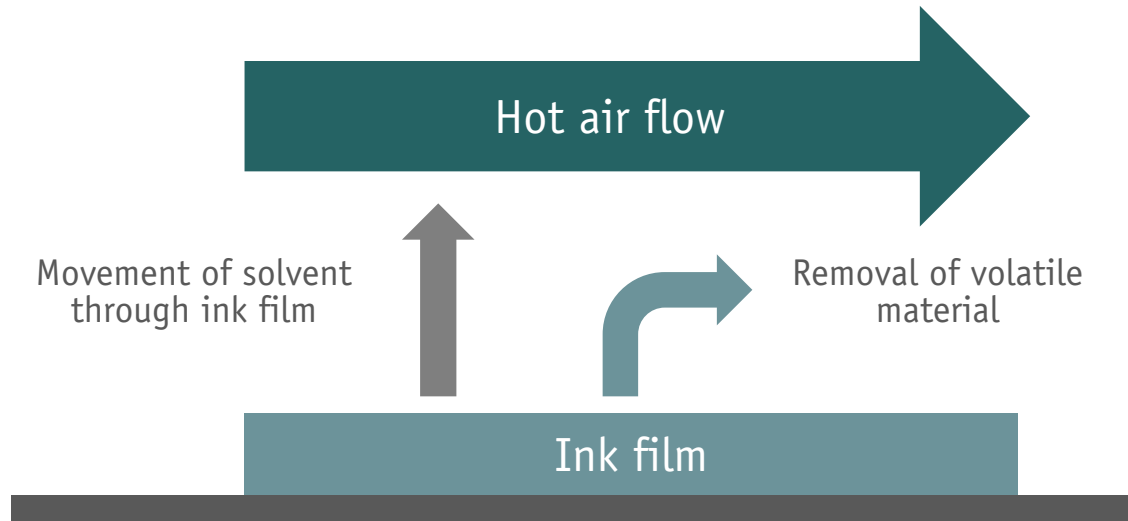
Drying: ✓ Water based
✓ Solvent based

Curing: ✓ UV
✓ EB

Droplet evaporation



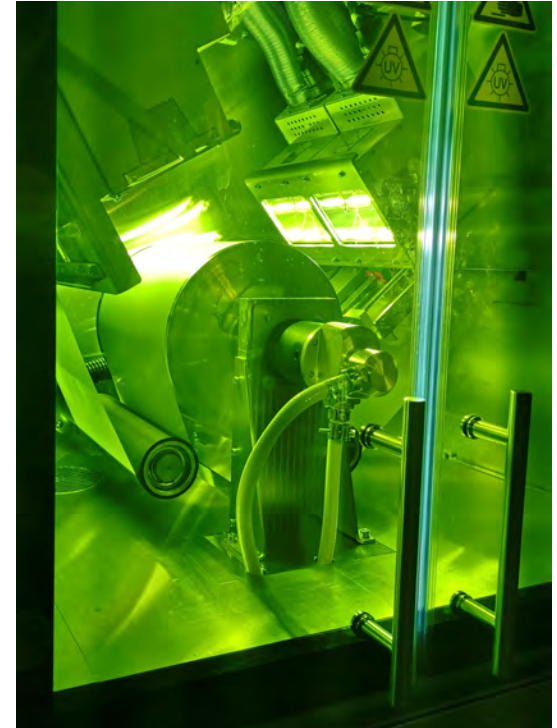
Evaporation



- ✓ To remove moisture from ink 3 factors must be present:
 - ✓ Heat (energy)
 - ✓ Air flow (turbulence/speed)
 - ✓ Low humidity
- ✓ Flow of „dry“ air on substrate to move vapour away from substrate
- ✓ Exhaust to remove vapour from within dryer

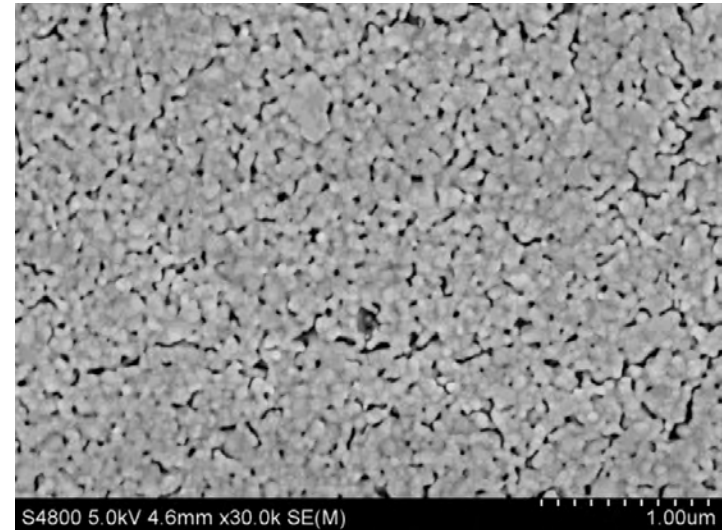
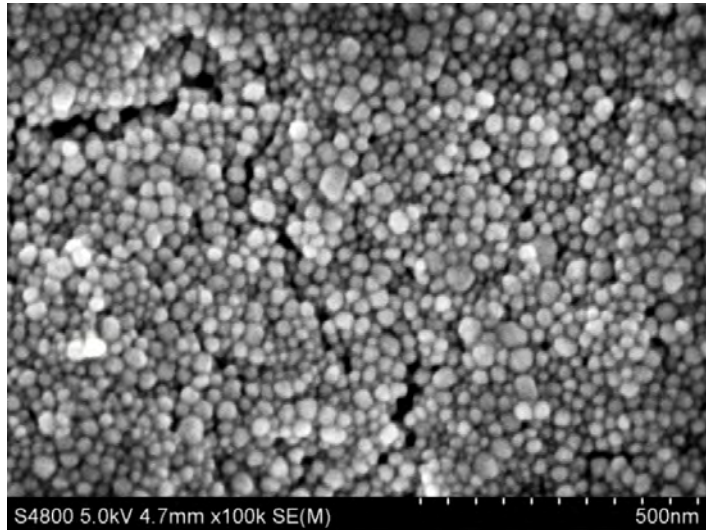
UV-curing systems

- ✓ High intensity UV light required
- ✓ Traditionally mercury vapour lamps
 - ✓ High light output
 - ✓ not easily switchable
 - ✓ High heat output
- ✓ UV-LED curing systems becoming popular
 - ✓ Output intensities increasing but still limited to low speeds
 - ✓ Useful as compact „pinning“ systems between colours
- ✓ Water or air cooling often used for maximum power output
- ✓ Light reflection from substrate to nozzles a problem

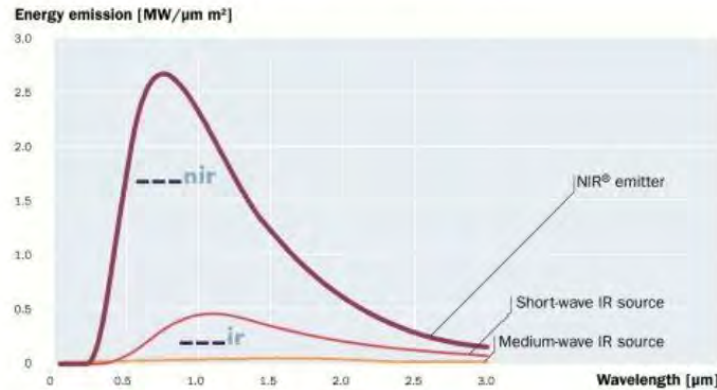
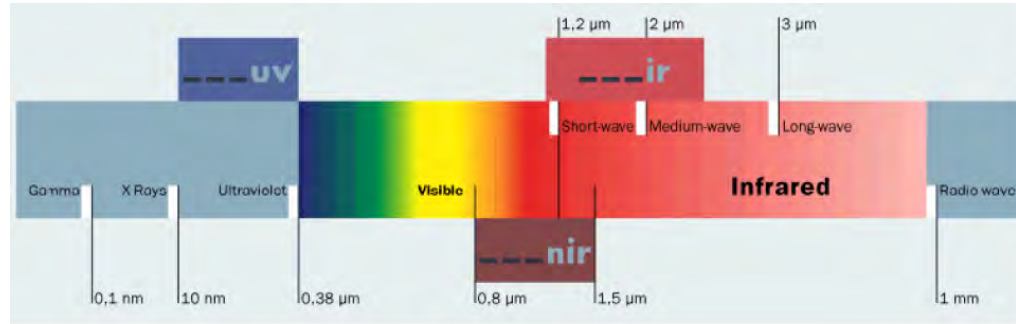


Silver nano-particle sintering

- ✓ Silver nanoparticles require sintering for optimum conductivity
 - ✓ Particles join forming a continuous highly conductive film
 - ✓ Conventional oven sintering: 130°C for 10 minutes

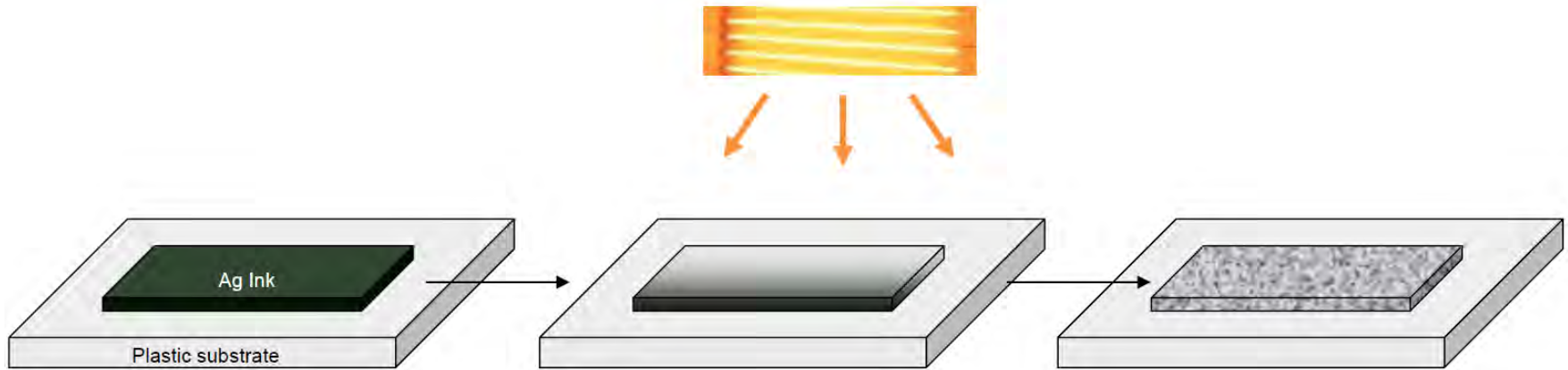


Near infrared in the EM spectrum



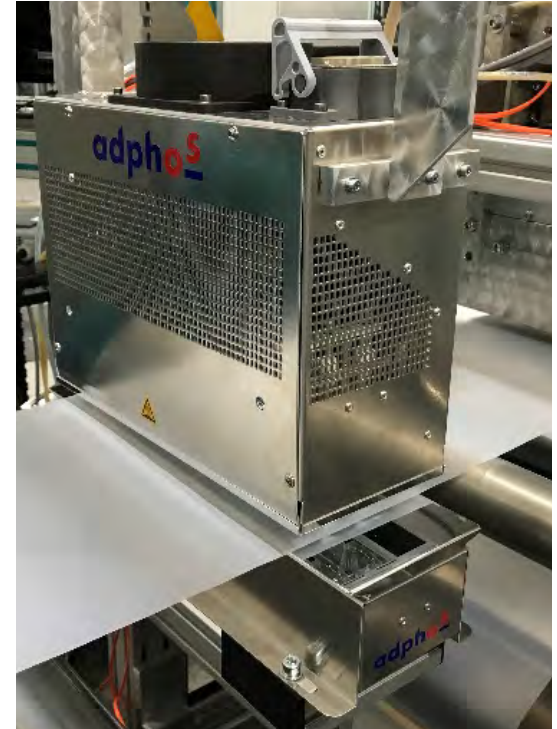
NIR sintering of Ag nanoparticle ink

- ✓ Ink is applied onto the plastic substrate
- ✓ Energy from the NIR lamp is absorbed by the wet ink rapidly drying and sintering it



Advantages NIR

- ✓ The ink absorbs ~90% of the NIR radiation when wet
- ✓ NIR penetrates the ink drying thick films
- ✓ Plastic substrates like PET transparent to NIR spectrum
→ no substrate damage



Summary

Introduction

Motivation

Inkjet printing

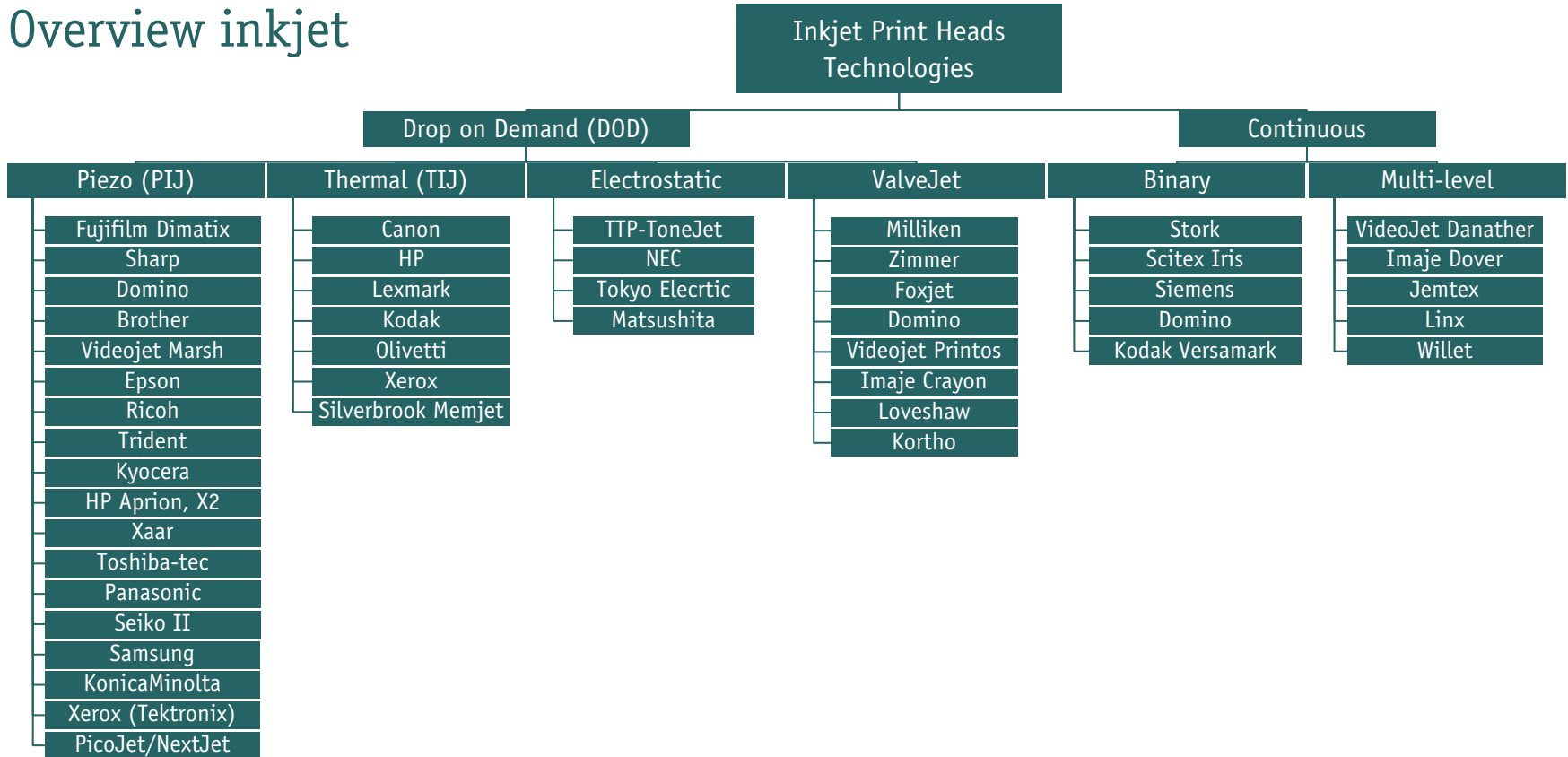
Inks

Printheads

Our status

Summary

Overview inkjet



Kyocera KJ4

- ✓ 4.25 inch print width
- ✓ 300/600 dpi
- ✓ 2,656 nozzles
- ✓ 30 – 40 kHz
- ✓ 75 m/min, 2 rows 150 m/min offset speed
- ✓ Designed by Brother, manufactured by Kyocera
- ✓ Aqueous and UV ink versions
- ✓ Up to 5 greyscale levels



Xerox

- ✓ Designed to be stacked in massive arrays
- ✓ Update of Tektronix printhead technology developed in 1990's
- ✓ Stacked stainless steel channel plates
- ✓ Roof mode piezo
- ✓ Uses phase change or aqueous inks



Fujifilm Dimatix

- ✓ Modular end shooter printhead
- ✓ Solvent & UV inks
- ✓ Some versions aqueous inks



Dimatix Q-Class

- ✓ Hybrid carbon-silicon construction
- ✓ 2.5 inch wide, 256 nozzles
- ✓ Q256/10
 - ✓ 10 pl drops for 1,200 dpi
 - ✓ 50 kHz binary
- ✓ Q256/30
 - ✓ 30 pl drops for 900 dpi
 - ✓ 33 kHz binary
- ✓ Support VersaDrop™ variable drop size technology



Source: Fujifilm USA

Dimatix Starfire SG-1024

- ✓ 20 – 30 pl drop size
- ✓ 8 – 20 cp inks
- ✓ 400 dpi, 1,024 channels in 8 rows
- ✓ Replaceable metal nozzle plate
- ✓ RediJet Technology
 - ✓ Enhanced on-head electronics
 - ✓ Continuous ink recirculation at the nozzle
 - ✓ Waveforms tailored to specify fluids



Source: Fujifilm USA

Fujifilm Samba printhead

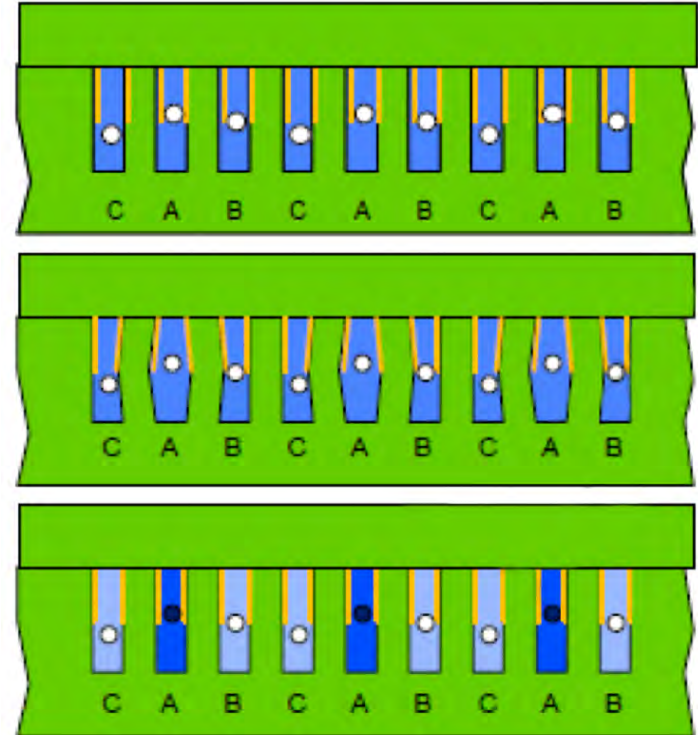
- ✓ Full MEMS construction
- ✓ 1 200 native dpi
- ✓ 2 pl drop size
- ✓ 2 048 nozzles per module
- ✓ Continuous ink recirculation
- ✓ Frequencies up to 100 kHz
- ✓ VersaDrop gray scale and multipulse capable
- ✓ Designed for large arrays



Source: Fujifilm USA

Xaar

- ✓ Moving wall technology
- ✓ Active licensees
 - ✓ Konica Minolta
 - ✓ SII Printek
 - ✓ Toshiba TEC



Xaar

- ✓ 1 000 Nozzles
- ✓ Print width 70.5 mm
- ✓ Horizontal or vertical orientation
- ✓ 360 nozzles/inch
- ✓ 6 m/s drop velocity
- ✓ 7 – 50 cP viscosity range
- ✓ Greyscale
 - ✓ 6 – 42 pl drops at 6 kHz
 - ✓ 12 – 84 pl at 6 – 12 kHz



Xaar

- ✓ Continuous through flow in the channels
- ✓ Fresh ink to nozzles
- ✓ Quick recovery from air ingestion
- ✓ Temperature stability



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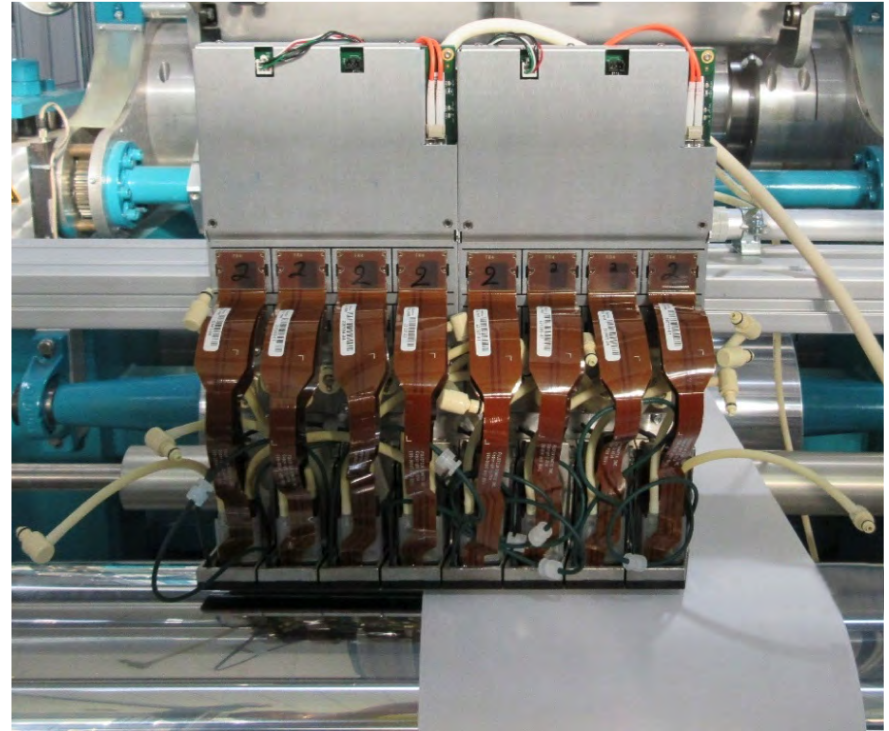
Summary

Inkjet process parameter

Ink chemistry	Inkjet processes	Print head control	Drying
<ul style="list-style-type: none"> ✓ Rheology ✓ Viscosity ✓ Ink or fluid ✓ Type of solvents ✓ Amount of solids ✓ Size of particles ✓ Sheer ratio ✓ Adhesion/Cohesion 	<ul style="list-style-type: none"> ✓ Print heads ✓ Ink delivery ✓ Color control ✓ Droplet control ✓ Substrate speed ✓ Layer thickness ✓ Printing accuracy 	<ul style="list-style-type: none"> ✓ Registration ✓ Print head controller electronic ✓ Material guiding system ✓ Inline parameter control ✓ Firmware ✓ Image conversion software 	<ul style="list-style-type: none"> ✓ Convection drying ✓ Contact drying ✓ Infrared drying ✓ Sintering ✓ NIR ✓ High frequency ✓ UV crosslinking systems
Substrate	Pretreatment	Environment	Finishing
<ul style="list-style-type: none"> ✓ Surface tension ✓ Dimension stability ✓ Surface structure ✓ Contact angle 	<ul style="list-style-type: none"> ✓ Corona ✓ Plasma ✓ Precoating to make the substrate print receptive 	<ul style="list-style-type: none"> ✓ Humidity ✓ Temperature ✓ Inert conditions ✓ Dry room 	<ul style="list-style-type: none"> ✓ Calendaring ✓ Embossing ✓ Slitting

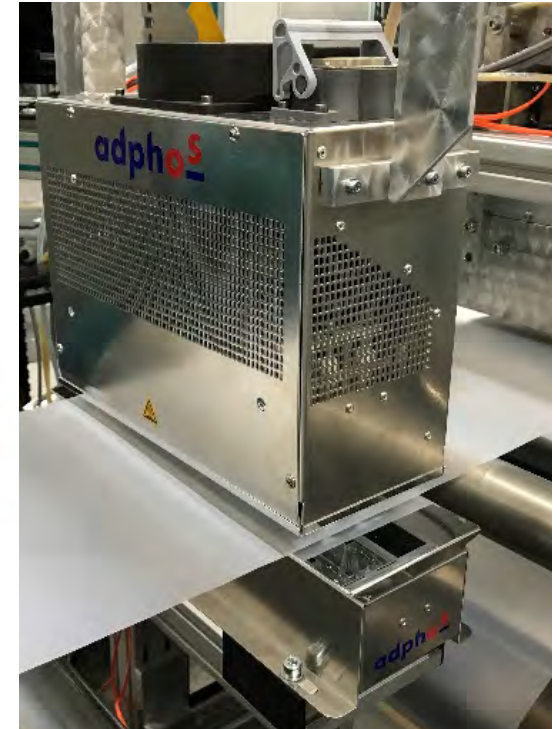
Integration of the „inking“ system – current status

- ✓ Printing head and mounting
(Fuji Dimatix Samba)
- ✓ Fluid recirculation system
- ✓ Power supply
- ✓ Computer

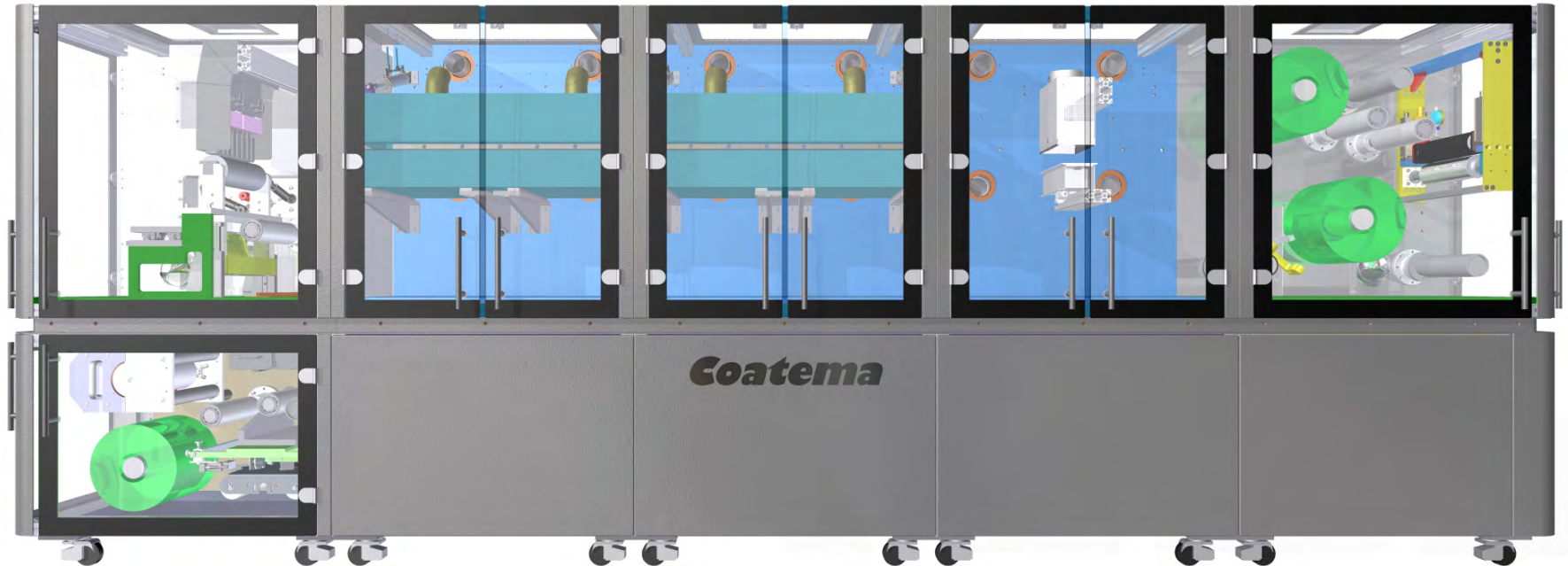


Integration of analysis and sintering units – current status

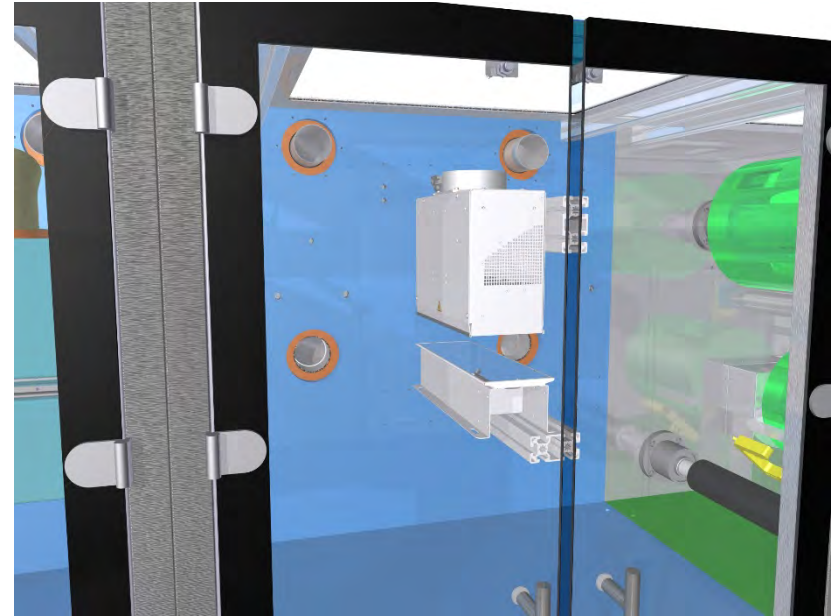
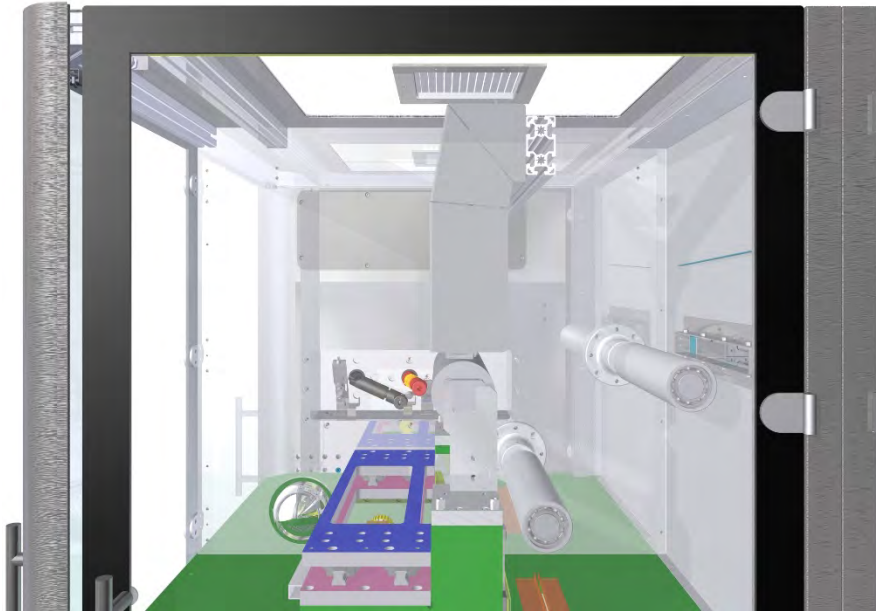
- ✓ Dantex dynamics „dropwatching“
 - ✓ Velocity
 - ✓ Size
 - ✓ Sphericity
- ✓ Drying/Sintering
 - ✓ Adphos NIR
 - ✓ IR lamp
 - ✓ Photonic sintering
 - ✓ Hot air dryer



Unit layout

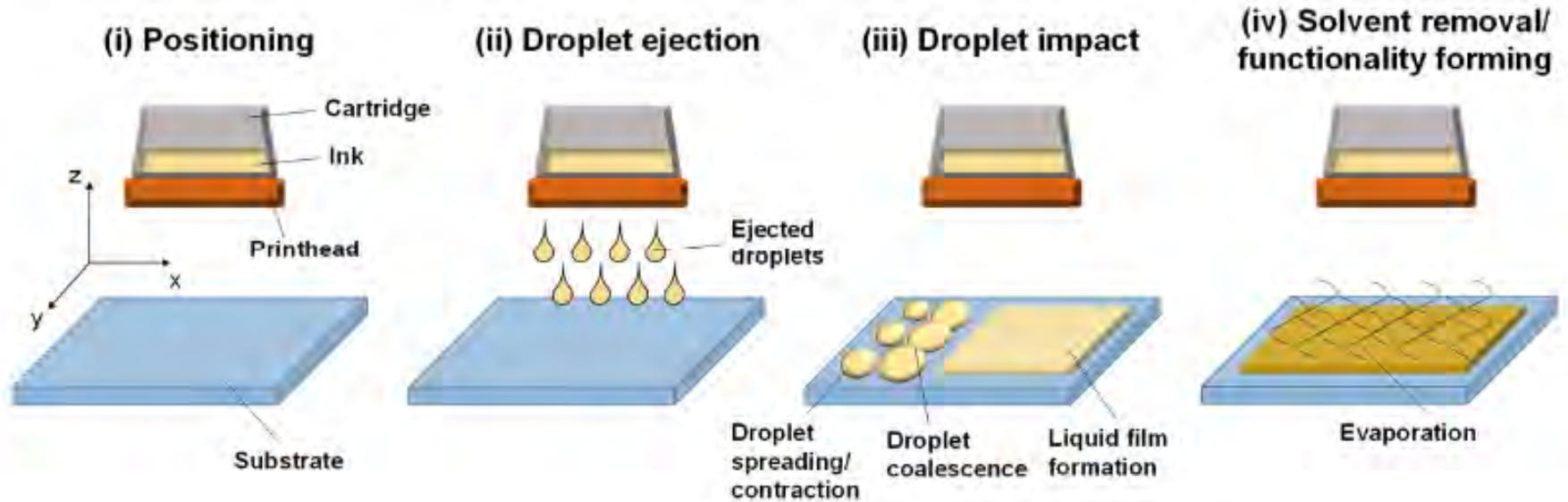


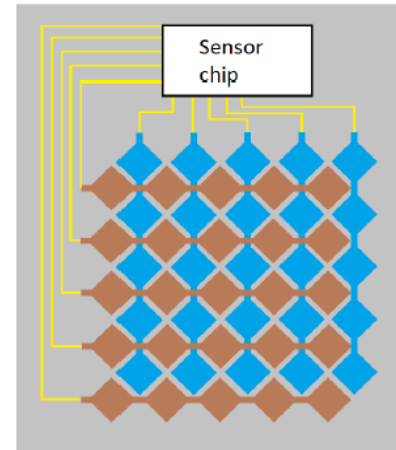
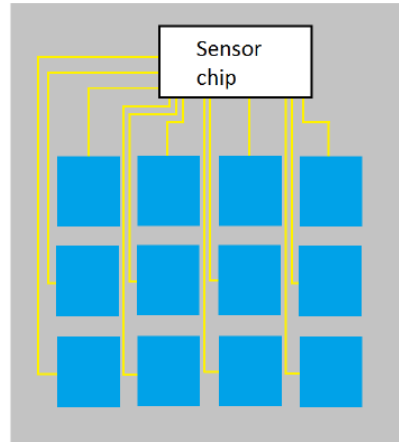
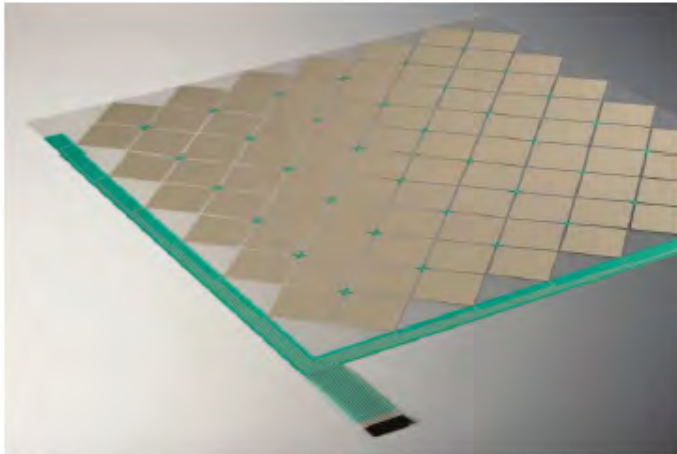
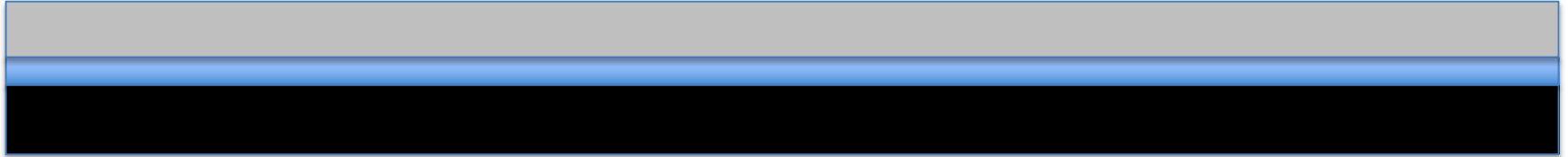
Unit layout



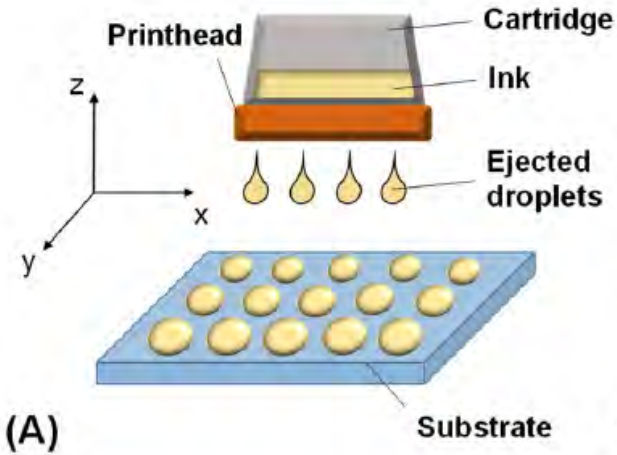
Integration – plans

- ✓ Combination of print heads with high precision granit stone
- ✓ Several sintering methods possible
 - ✓ Hot air dryer to remove solvents (LEL)
 - ✓ NIR/IR/Photonic sintering for conductivity
- ✓ Droplet analysis
- ✓ Possibility to combine Inkjet with NIL

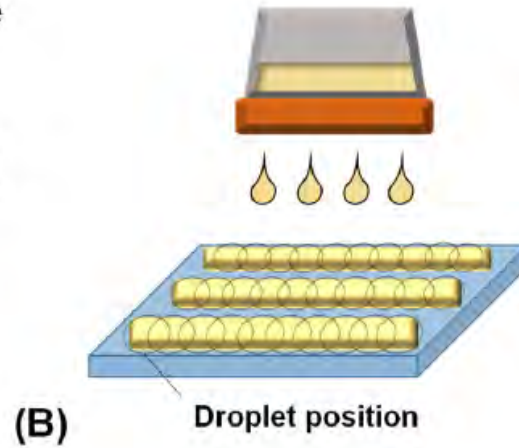




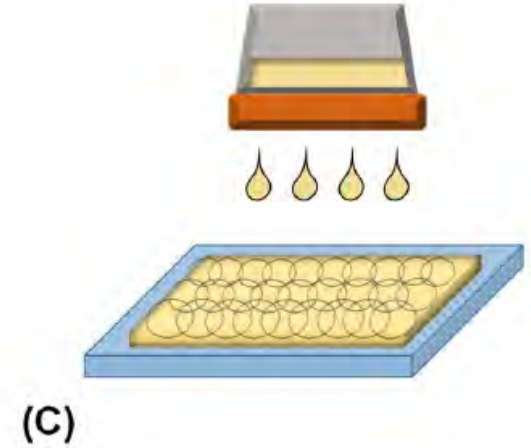
(i) Single droplets

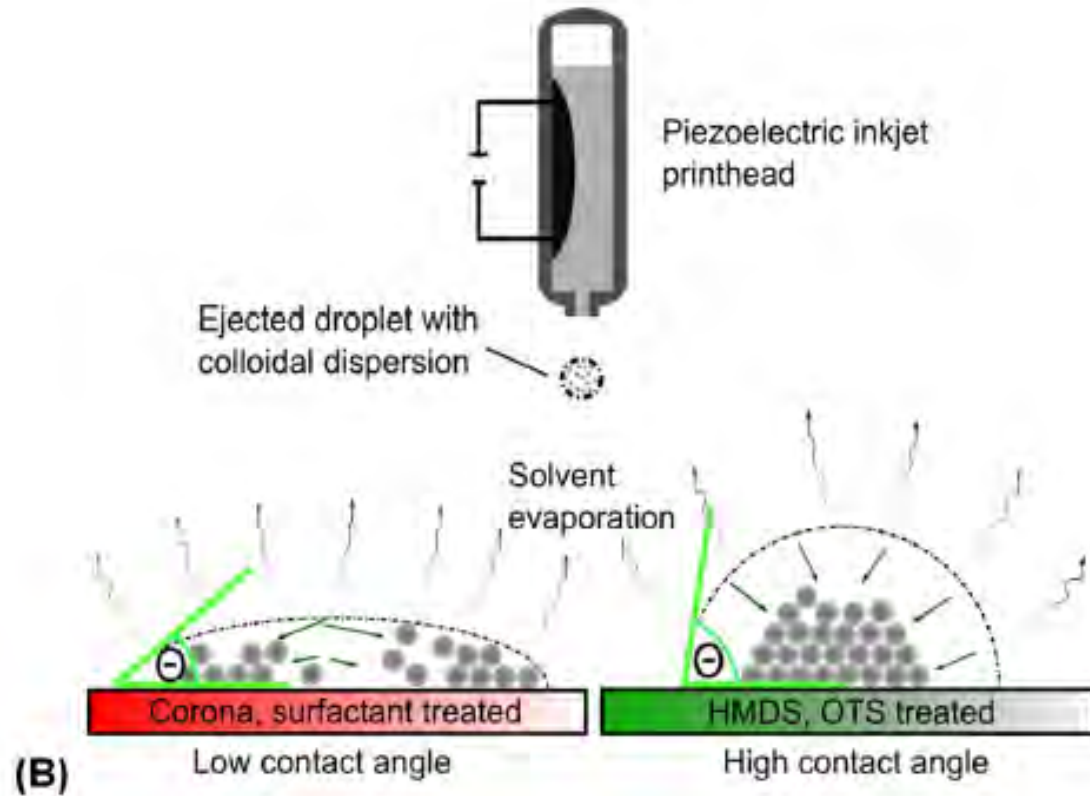


(ii) 1D films



(iii) 2D films





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Coatema Inkjet printing

- ✓ Inkjet technique provides flexibility and steps towards functional features e.g. printed electronics, packaging, textile and way more customizable products
- ✓ Integration of complete different inkjet systems and printheads into R2R machinery with high speed
- ✓ Inkjet printing is fast, precise, flexible and scalable
- ✓ Diversity in ink formulations and drying methods depending on the application
- ✓ Possibility of printing complex structures in micro scales with a high resolution and fine lines

Do not hesitate to contact us!



Anything missing?

Let us know and we will make it happen!

Our R&D centre is worldwide the most versatile centre for coating, printing and laminating.

Sales department:
sales@coatema.de

Thank you



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