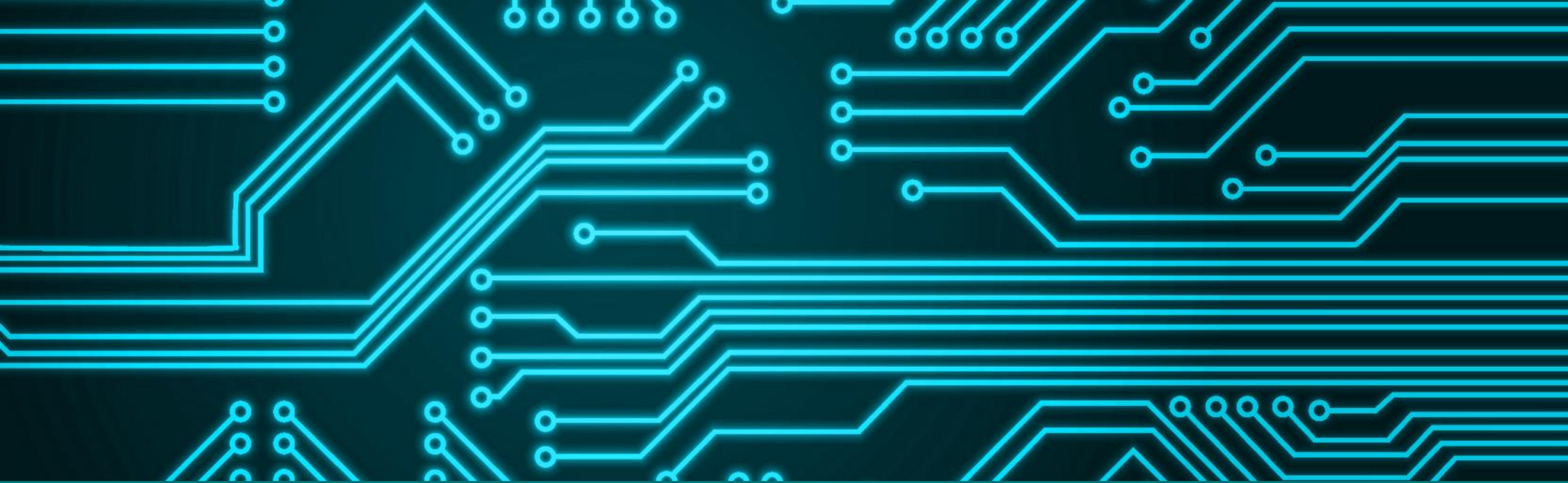


Coatema

Coatema Inkjet printing

12/08/25

MEMBER OF ATH

Agenda

1. Introduction
2. Motivation
3. Inkjet printing
4. Inks
5. Printheads
6. Our status
7. Summary

1.

Introduction

Overview

Quality
made in Germany

Part of the ATH Holding

S2S equipment

R2R equipment

Bespoke
equipment

Innovations

Coating

Printing

Laminating

Founded
1974

Printed electronics
Fuel cells
Membranes
Pharmaceutics
Solar
Batteries
Prepregs
Green Hydrogen

From lab 2 fab

R&D
projects & network

Worldwide
service

Group of companies

ATH ALTONAER TECHNOLOGIE HOLDING

KROENERT

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

DRYTEC

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

Coatema® Coating Machinery GmbH

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

Represented worldwide

Coatema equipment platform strategy for lab2fab

Lab

- ✓ State-of-the-art research and development equipment
- ✓ Sheet-to-sheet to roll-to-roll systems on smale scale & footprint

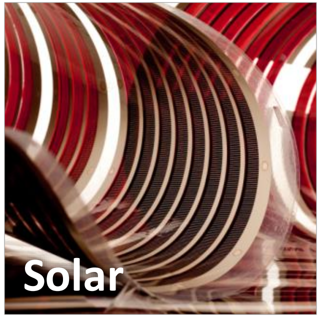
Pilot Production

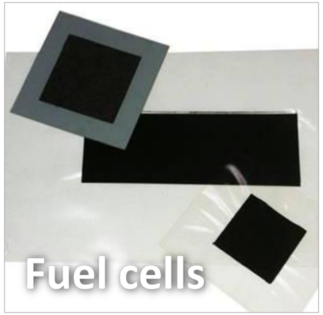
- ✓ Proven processes for printing, coating and laminating equipment
- ✓ Highest-quality pilot lines enable stable pilot production and reduce cost of operation
- ✓ Scaling laboratory equipment to enable pilot production

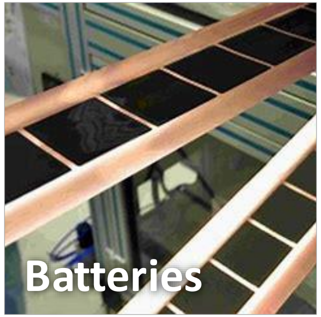
Production

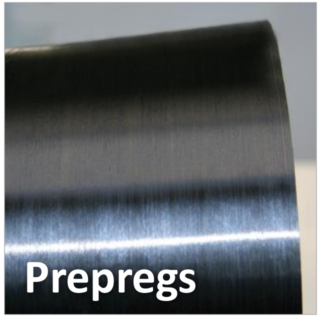
- ✓ Full-scale production lines
- ✓ Optimize the manufacturing process, including streamlining assembly, reducing material waste, and optimizing the carbon footprint

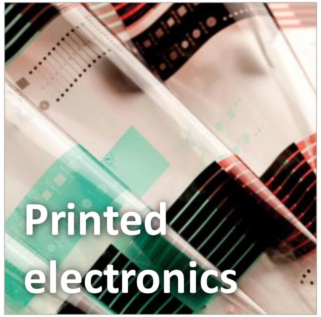
Our markets











Actual system proven in operational environment

TRL 9
TRL 8
TRL 7
TRL 6
TRL 5
TRL 4
TRL 3
TRL 2
TRL 1

Basic principles observed

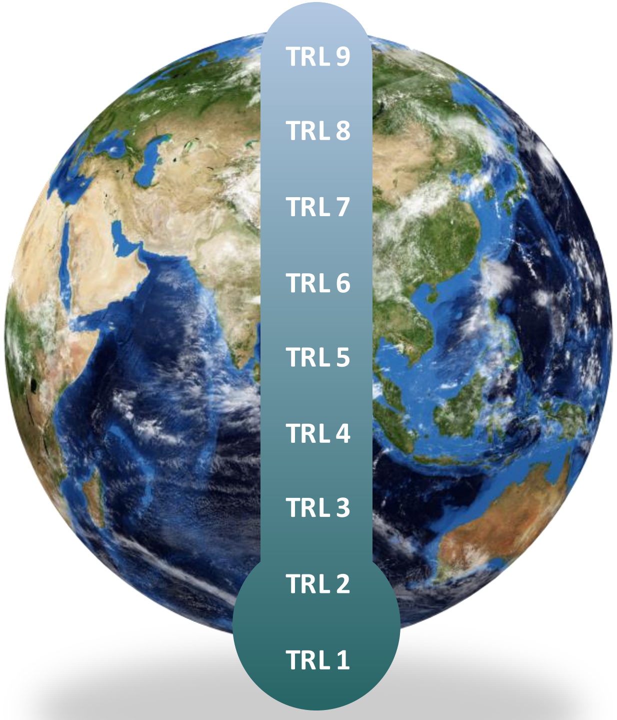
Our markets – Coatema focus areas

Green Hydrogen

Fuel cells

Batteries

Solar



Sustainability

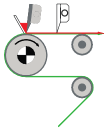
Digital fabrication

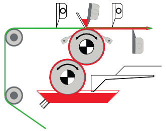
Printed electronics

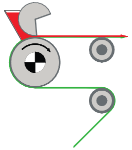
The next thing

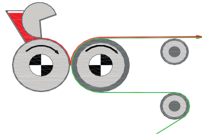
Coatema® Coating Machinery GmbH

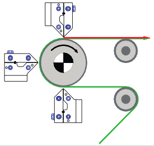
Coating systems

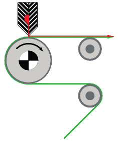

Knife system

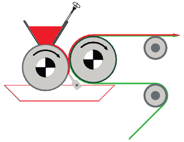

Double side coating system

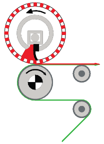

Commabar system

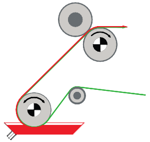

Reverse commabar system

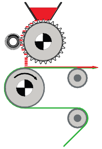

Slot die system

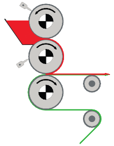

Curtain coating system

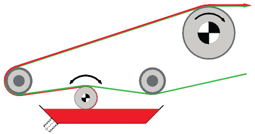

Case knife system

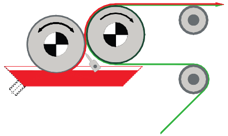

Rotary screen system

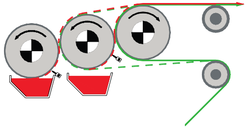

Dipping system (Foulard)

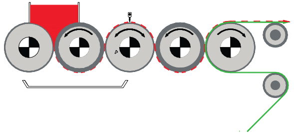

Powder scattering system


Reverse roll coating system

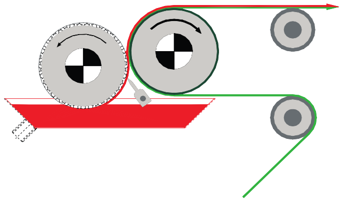

Micro roller coating system


2-roller coating system

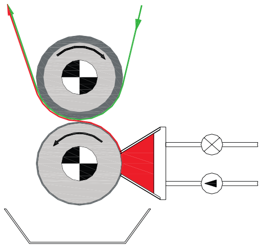

3-roller combi coating system


5-roller coating system

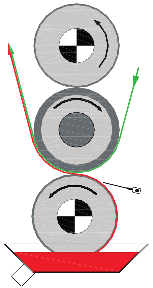
Printing systems



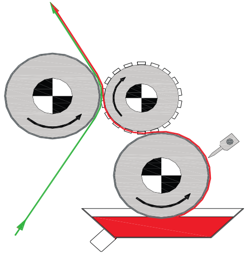
Engraved roller system



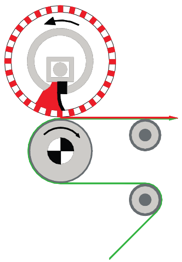
Gravure roller system



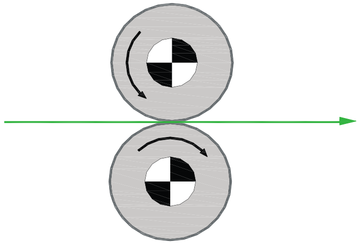
Gravure indirect system



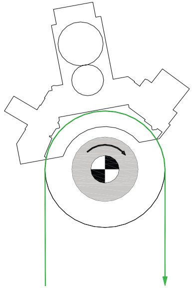
Flexography system



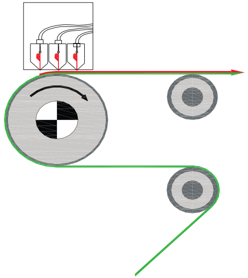
Rotary screen system



Hot embossing system



Nanoimprint system



Inkjet system

Our work in associations – global networking

Board Member:
OE-A

Advisory Board:
Fraunhofer ITA

Coatema customers

Coatema® Coating Machinery GmbH

R&D customers

TECHNISCHE UNIVERSITÄT DRESDEN

KIT Karlsruhe Institute of Technology

Agency for Science, Technology and Research SINGAPORE

THE UNIVERSITY OF ARIZONA

UNSW SYDNEY

Queen Mary University of London

ARISTOTLE UNIVERSITY OF THESSALONIKI

TTRI Taiwan Textile Reasarch Institute

ITA Institut für Textiltechnik und Lehrstuhl für Textilmaschinenbau

RWTH AACHEN UNIVERSITY

NREL Transforming ENERGY

RUHR UNIVERSITÄT BOCHUM RUB

TECHNICAL UNIVERSITY OF LIBEREC www.tul.cz

hochschule hof University of Applied Sciences

Deutsches Textilforschungszentrum Nord-West German Textile Research Centre North-West

cea

CSIRO

Fachhochschule Kiel Hochschule für Angewandte Wissenschaften

CENTI Centre for Nanotechnology and Smart Materials

FILK Forschungsinstitut Leder und Kunststoffbahnen

THE OHIO STATE UNIVERSITY

Hochschule Niederrhein University of Applied Sciences

Georgia Institute of Technology

UNIVERSITY OF CAMBRIDGE

Neue Materialien Fürth

JOANNEUM RESEARCH

HERIOT WATT UNIVERSITY

SW

DITF DEUTSCHE INSTITUTE FÜR TEXTIL+FASERFORSCHUNG

JÜLICH FORSCHUNGSZENTRUM

NATIONAL UNIVERSITY of MONGOLIA

VTT

TNO innovation for life

eurecat Centre Tecnològic de Catalunya

Fraunhofer IMM

Fraunhofer LBF

KITECH Korea Institute of Industrial Technology

Holst Centre Open Innovation by imec and TNO

Hochschule Reutlingen Reutlingen University

tecnalia

Fraunhofer IAP

Fraunhofer IAF

Fraunhofer ILT

Fraunhofer IFAM

Fraunhofer ISC

Fraunhofer FEP

Fraunhofer IVV

Fraunhofer ISE

Fraunhofer ICT

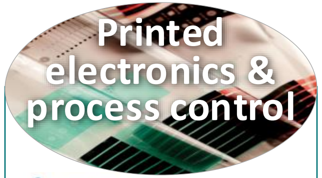
Fraunhofer PYCO

Fraunhofer IPT

Fraunhofer IWM

Coatema®
Coating Machinery GmbH

R&D projects overview 2022 – 2025

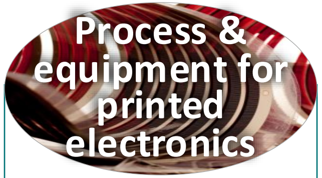


REAL NANO

In-line and real-time digital nano-characterization for flexible organic electronics

NOUVEAU

The NOUVEAU project will develop solid oxide cells (SOCs) with innovative La- and PMG-free electrode materials

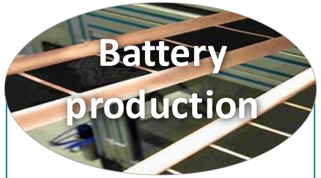


FLEX2ENERGY – AUTOMATED MANUFACTURING PRODUCTION LINE FOR IPVS

R2R production line for OPV solar with integrated backend

FLEX-G 4.0

Upscaling and development of EC based switchable films to decrease energy use in buildings



IDEEL

Implementation of laser drying processes for lithium-ion battery production

SOLiD

R2R process optimization for solid state batteries

PEP LAT

Plasmonically enhanced photocatalysis for wastewater treatment

ROLL 2 SOL

R2R nanostructuring of functional films

WATER PROOF

The WaterProof project aims at developing an electrochemical process that converts CO_2 emission

FLEX FUNCTION 2 SUSTAIN

Creating an open-innovation testbed for sustainable packaging

2.

Motivation

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.

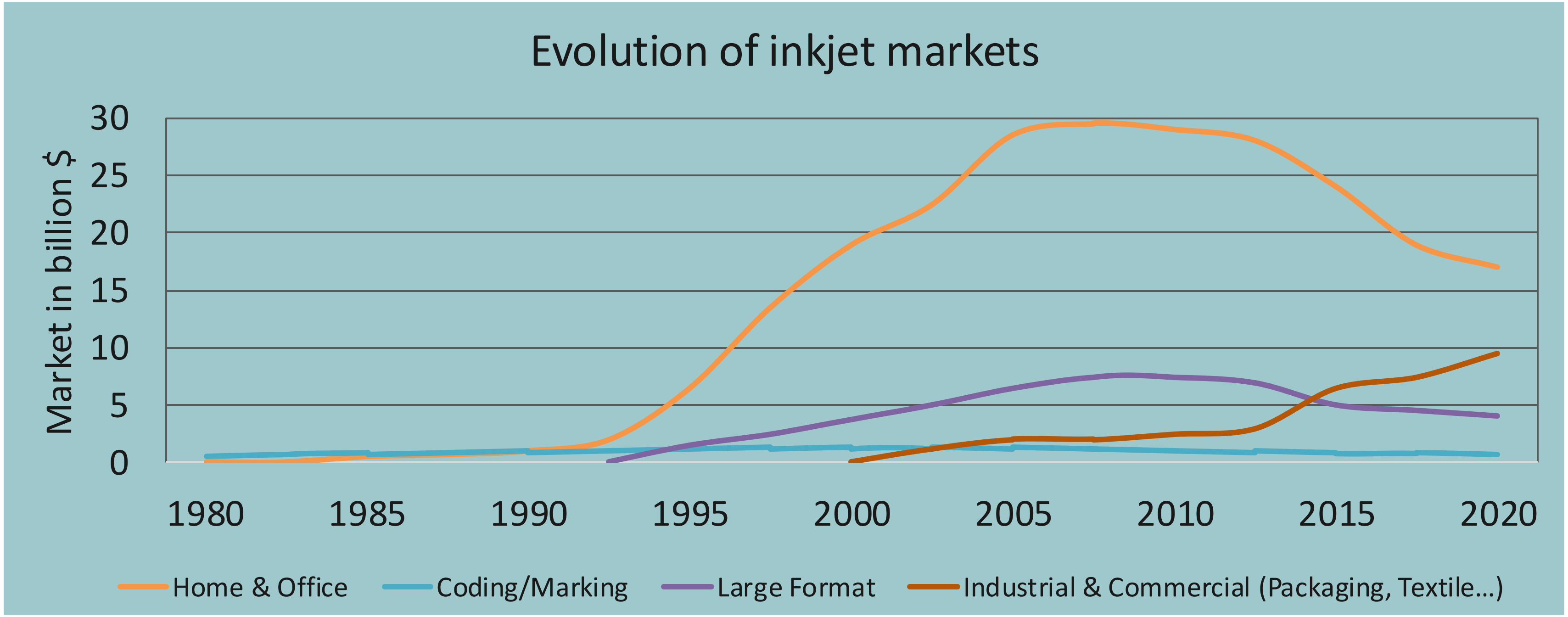
Source: Hue P. Le, Journal of Imaging Science and Technology, Vol. 42, Nr. 1, Jan/Feb 1998

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

Source: Hue P. Le, Journal of Imaging Science and Technology, Vol. 42, Nr. 1, Jan/Feb 1998

Increasing market



Source: Hue P. Le, Journal of Imaging Science and Technology, Vol. 42, Nr. 1, Jan/Feb 1998

Understanding inkjet printing process

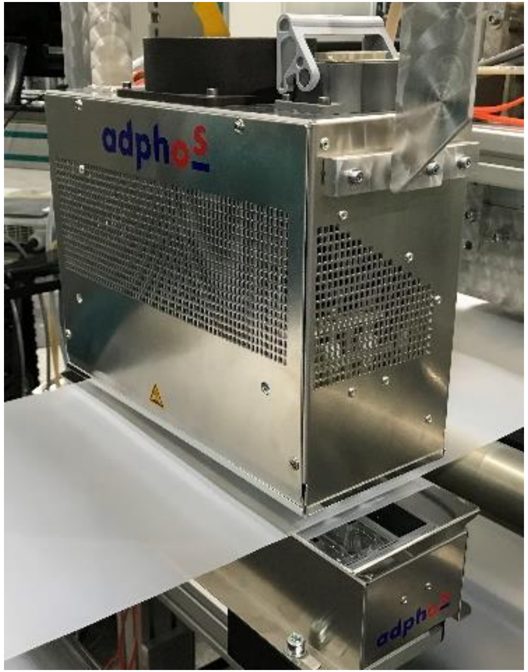
- ✓ Managing an ink through printhead engineering
  - ✓ Microfludic properties along fine capillary channels
  - ✓ Maintaing ink properties at the meniscus
  - ✓ Fromation of droplets
  - ✓ Consistent jet stability

Source: Hue P. Le, Journal of Imaging Science and Technology, Vol. 42, Nr. 1, Jan/Feb 1998

3.

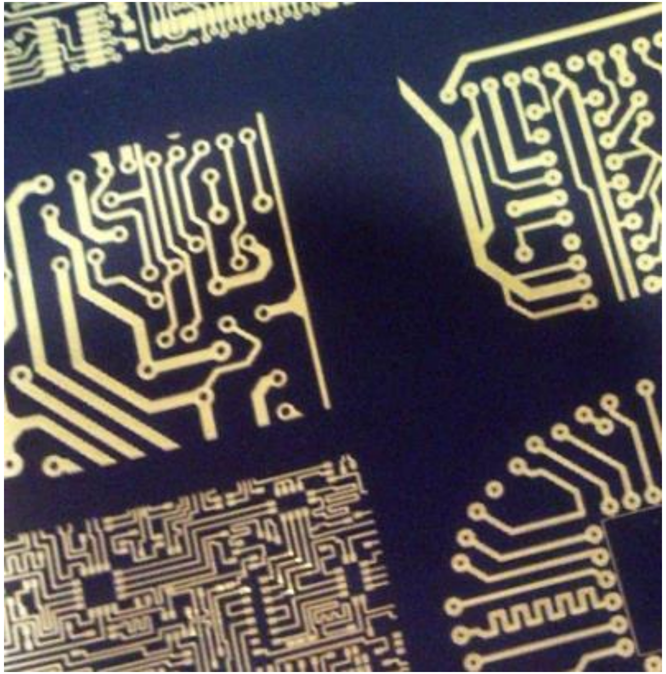
Inkjet printing

Aspects of inkjet printing



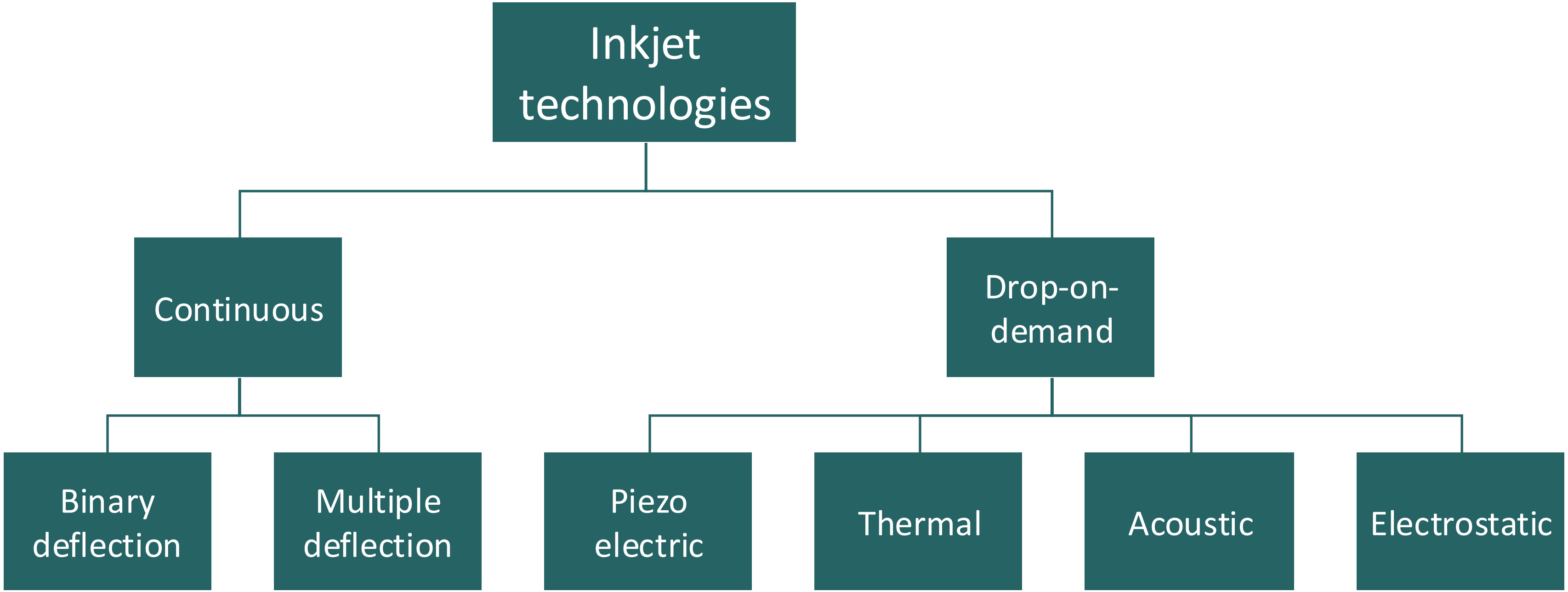
- ✓ Print head technique
- ✓ Ink details
- ✓ Inks positioning
- ✓ Drop watching
- ✓ Curing

Applications

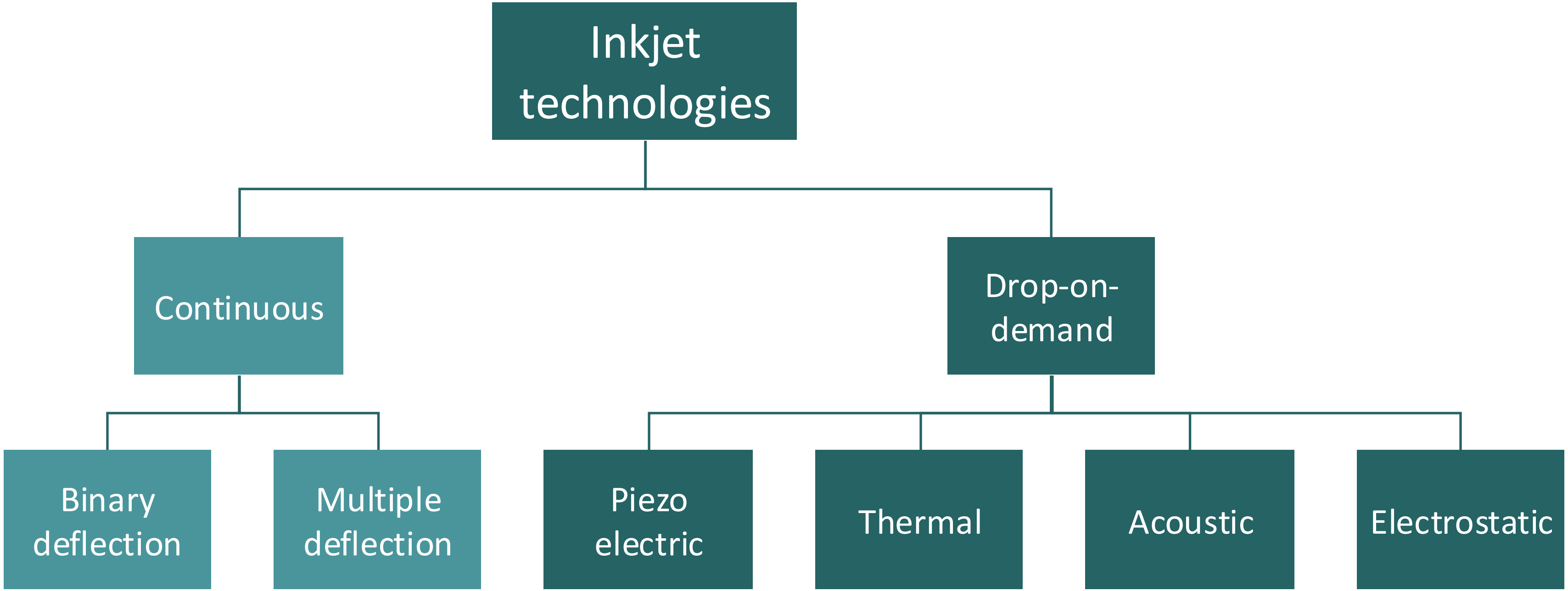


- ✓ Electronics
- ✓ Packaging
- ✓ Decoration
- ✓ Ceramic tiles
- ✓ Plastic cards

Different techniques



Different techniques

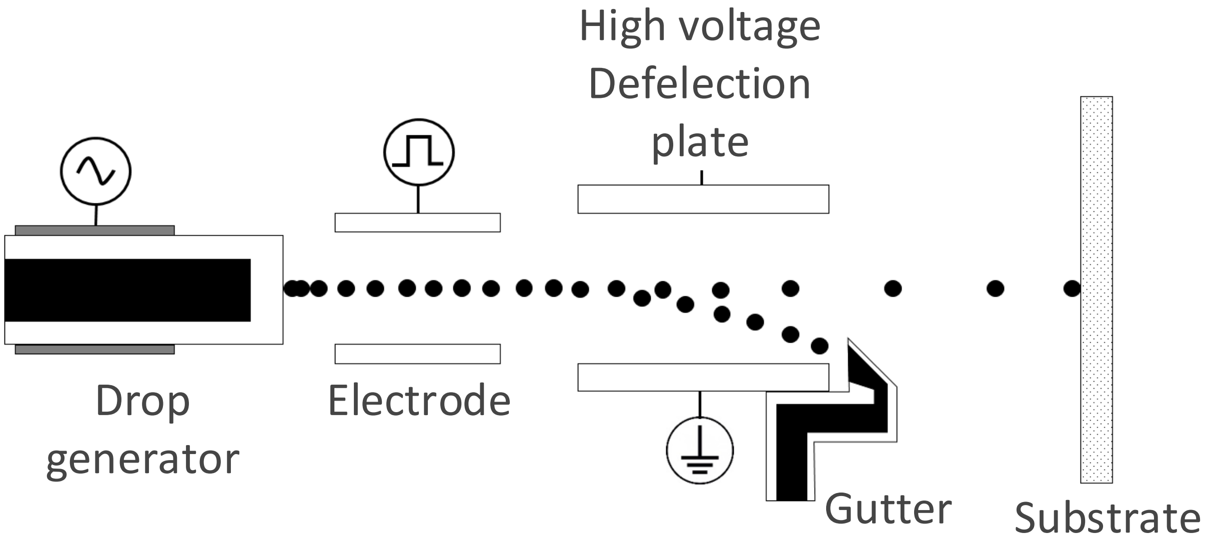


Inkjet on demand

Piezo DOD

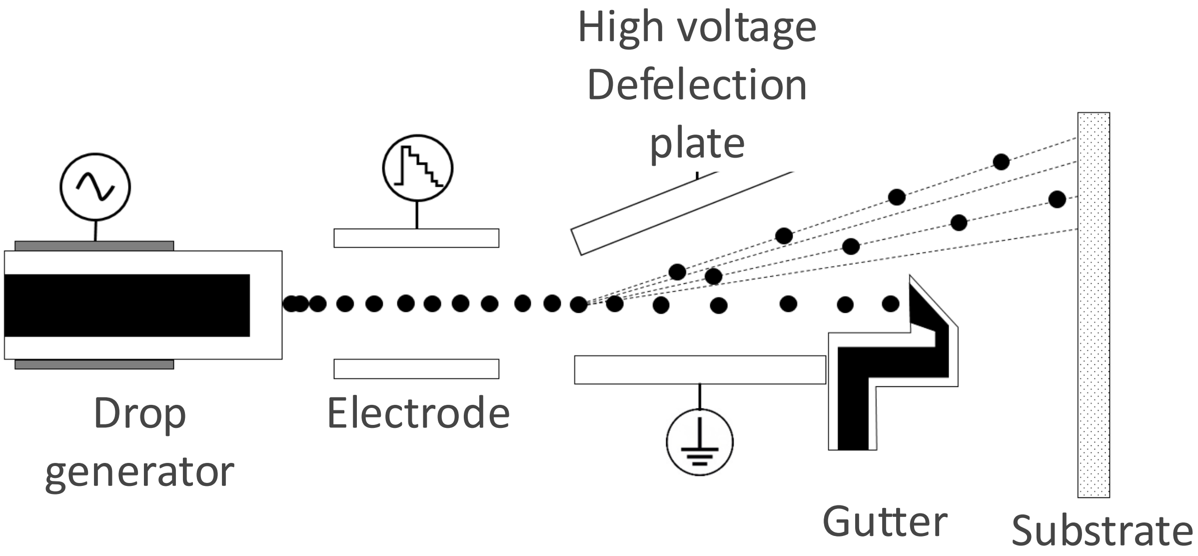
Push mode (Piston/Bump)	Bend mode	Squeeze mode	Shared wall Shear mode	Shear mode
• Ricoh • Trident • Brother • Epson	• Sharp • Epson • Xerox • (Tektronix) • PicoJet • Diamatix • Samba & M-class • Kyocera	• Siemens • Gould	• XAAR • Konica Minolta • ToshibaTec • Seiko II • Brother • Kodak • MicroFab	• Dimatix

Multiple deflection



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

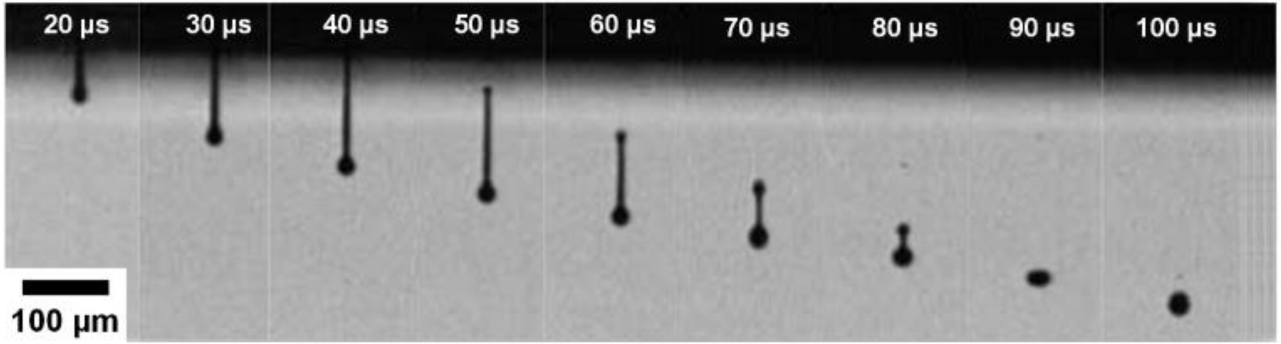
Binary continuous inkjet



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

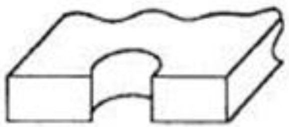
Spezifications and requirements

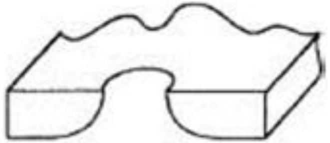
- ✓ Surface tension 28 – 32 dynes/cm
- ✓ Rheology 2 – 30 mPas
- ✓ Drop volume down to 0.2 ml

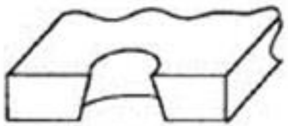


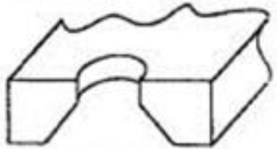
Drop formation cycle with 10 µs intervals after application of the waveform to the pietzoelectric transducer
(inkjet printhead: Fujifilm Dimatix QS256, ink: ANP DGP 40LT-15C)

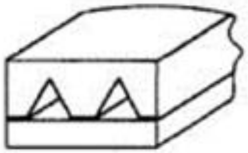
Nozzel design

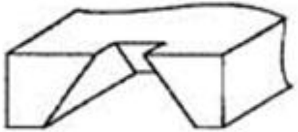

Cylindrical orifice
(Tektronix Sharp)


Convergent orifice
(HP, Dataproducts)


Tapered orifice
(Canon)

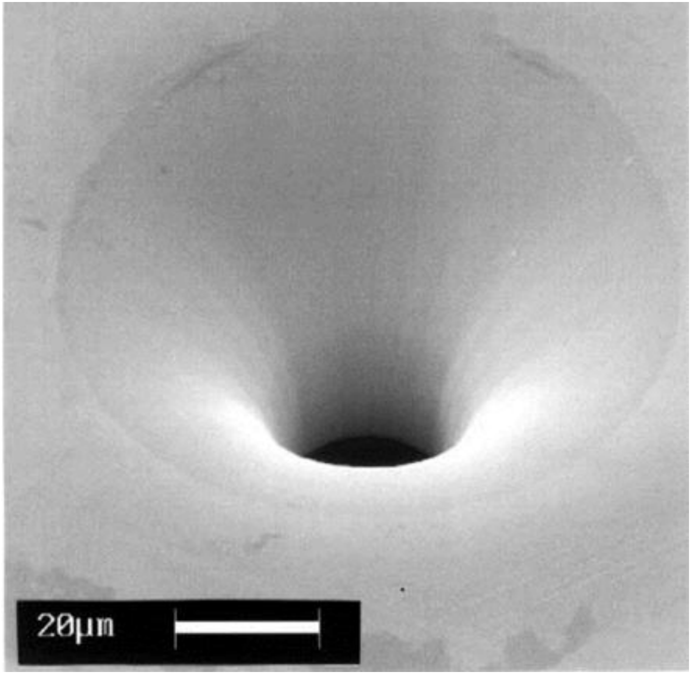

Tapered with cylindrical exit orifice (Seiko-Epson)


Triangle orifice
(Xerox)


Square orifice
(IBM)

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

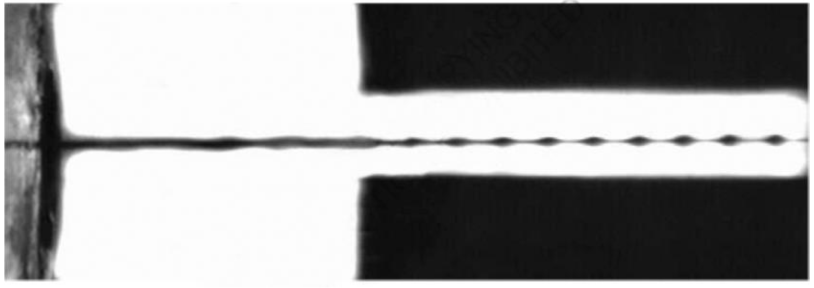
Nozzel design



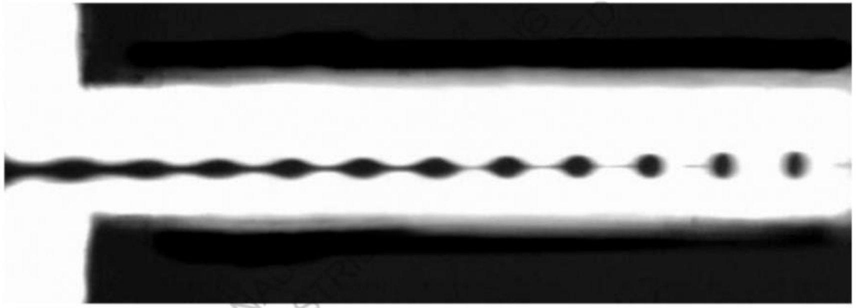
Electroplated Ni-nozzle

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

Droplet formation

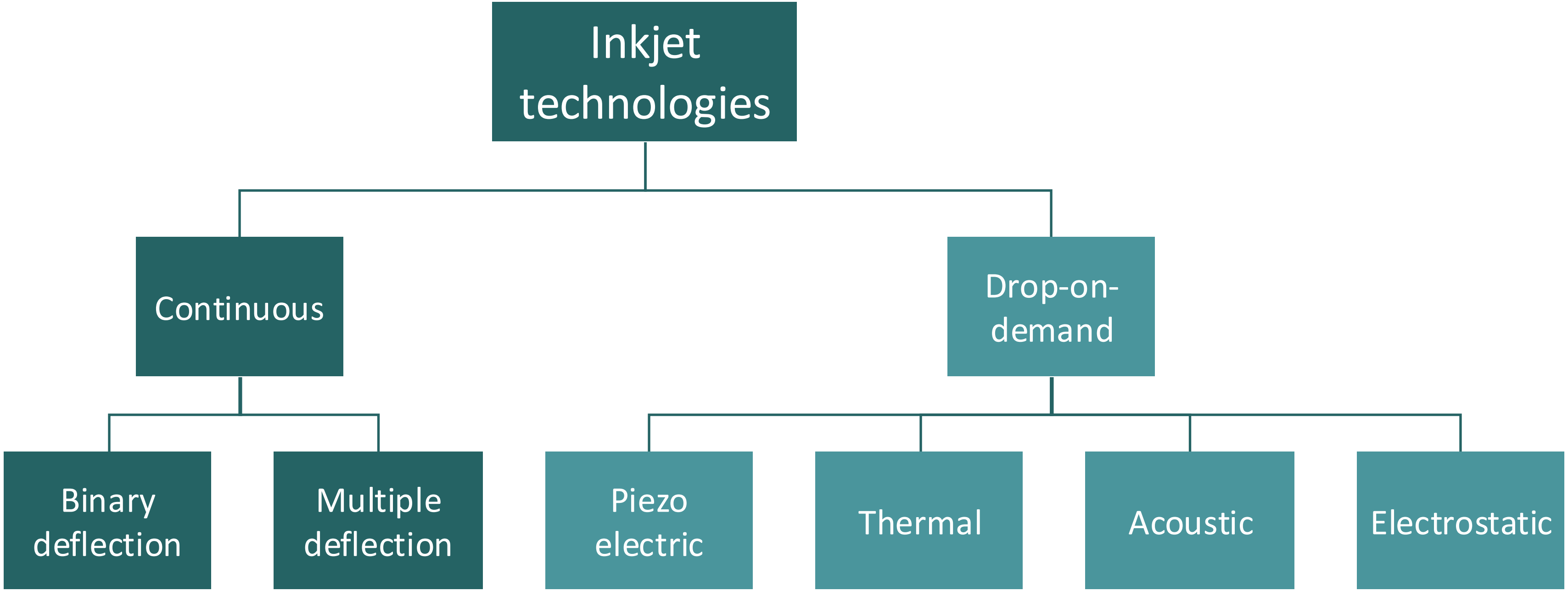


A continuous jet exiting the nozzle and travelling through the charge electrode

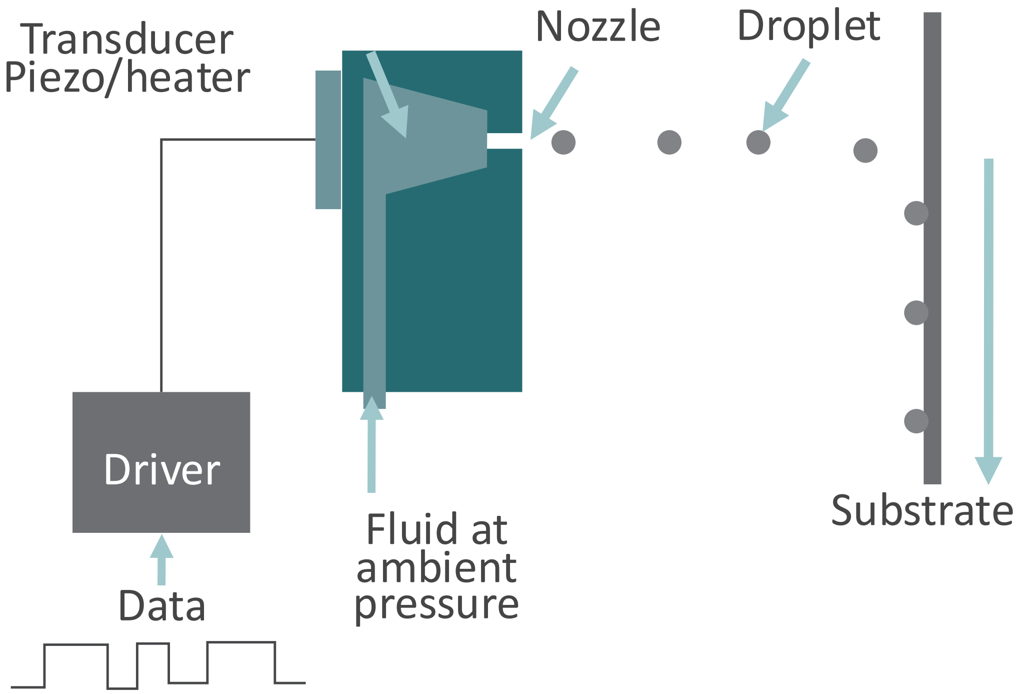


A continuous jet showing tails – the start of erratic ligament formation

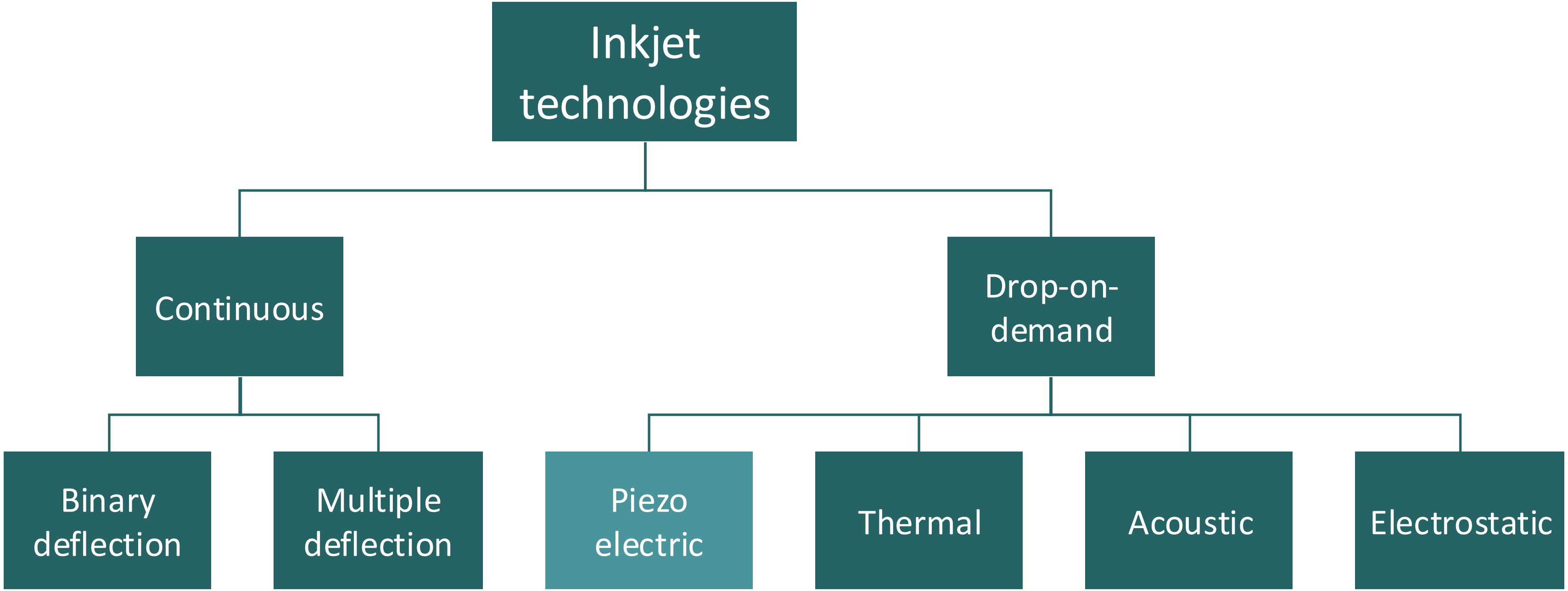
Different techniques



Drop on demand technique



Different techniques

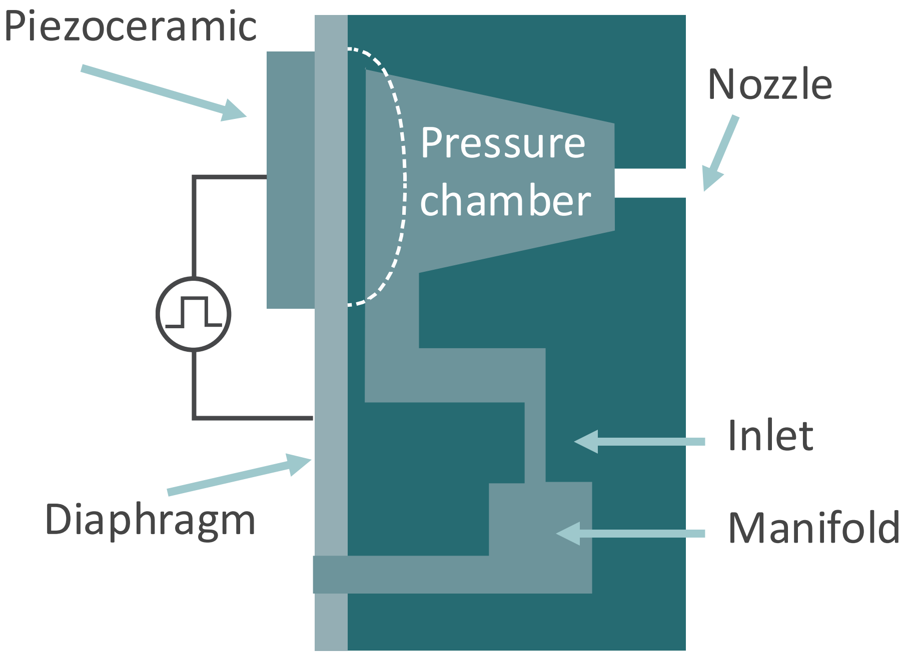


Working function piezo head

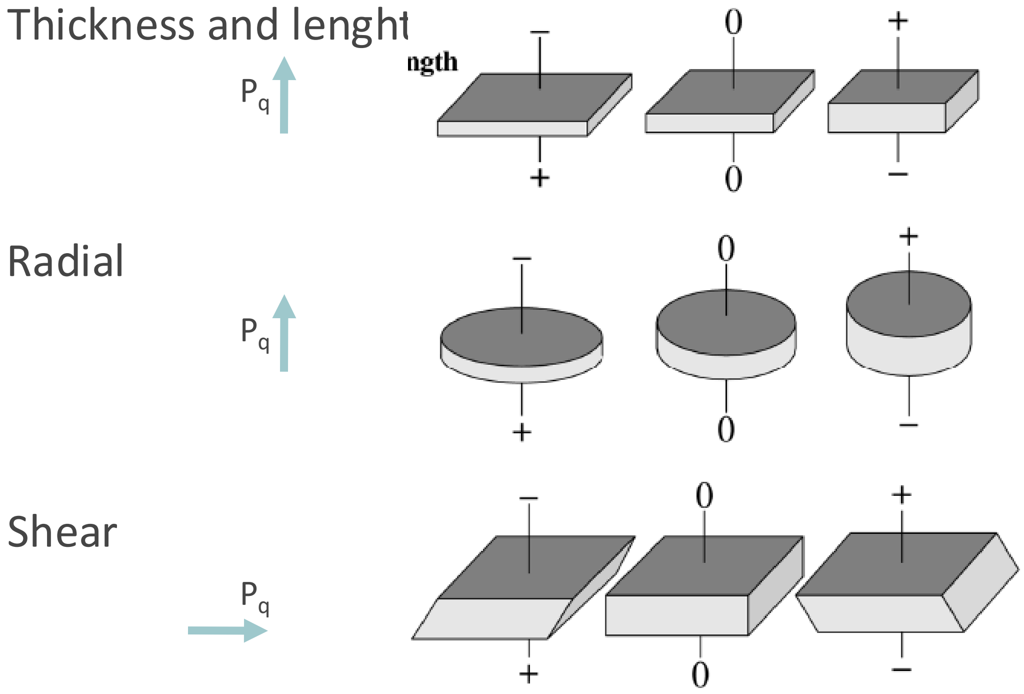
- ✓ Impulse method by deformation of piezo ceramic
- ✓ Change in pressure chamber volume
- ✓ Pressure wave propagates to nozzle

Problem: miniaturization

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



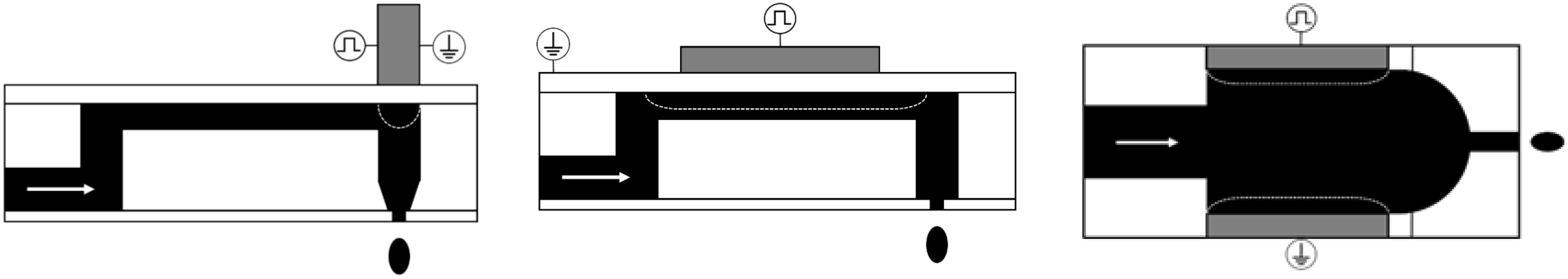
Different deformation for piezo elements



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

Piezo inkjet modes

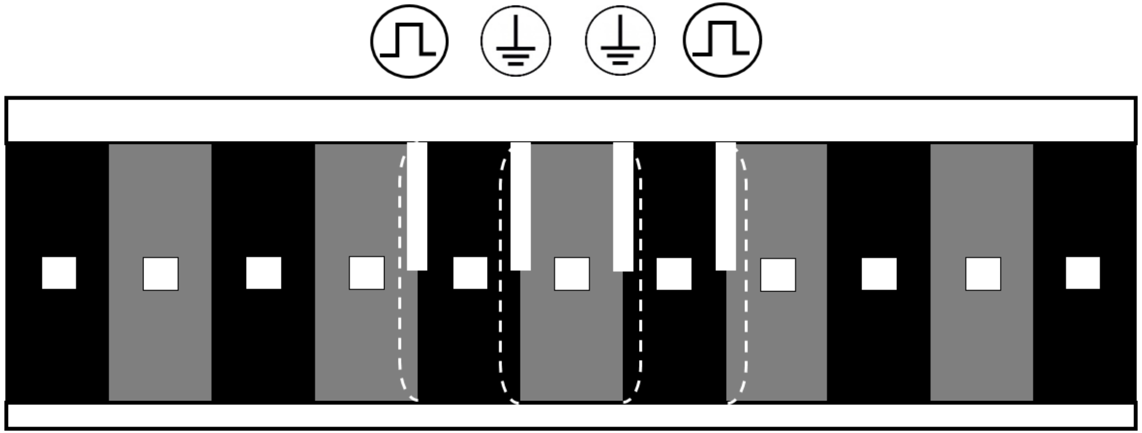
✓ Different techniques for drop generation



Push | Bend | Squeeze

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

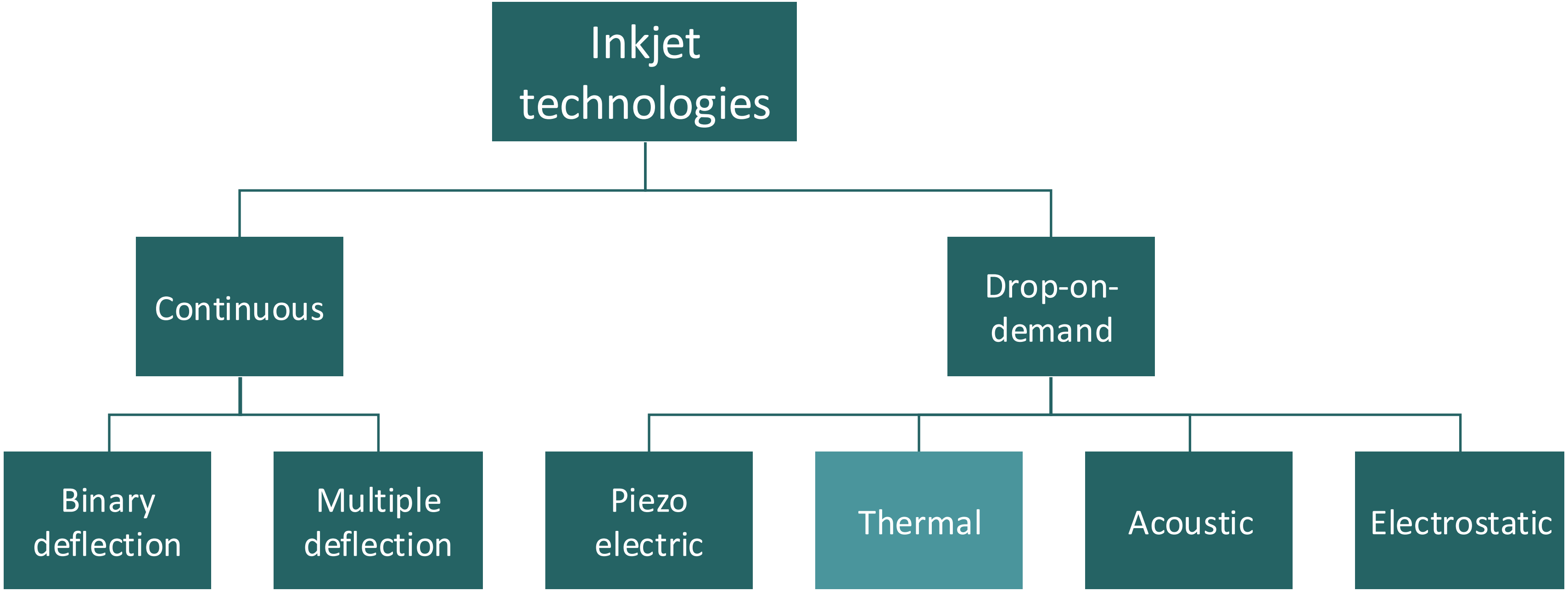
Piezo inkjet modes – shear



- ✓ 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

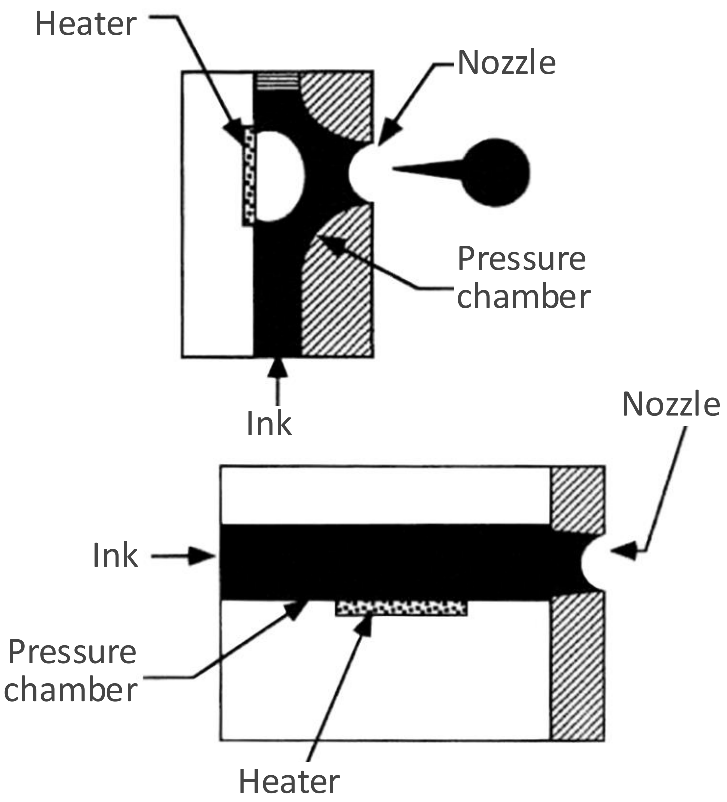


Thermal inkjets

Commercially most successful

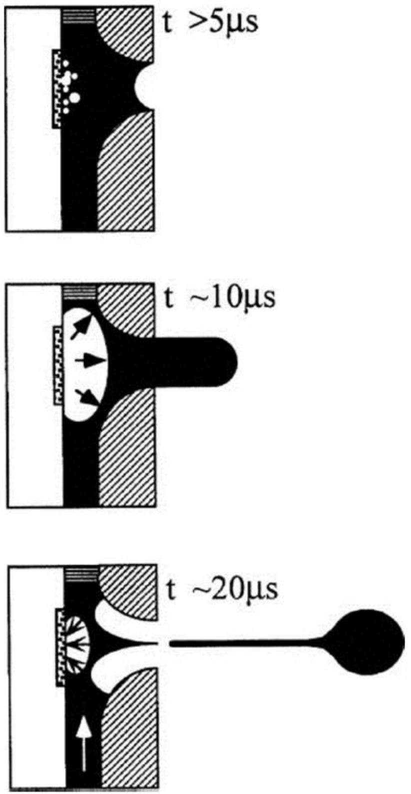
1. Roof shooter
   ✓ Heater above orifice

2. Side-Shooter
   ✓ Heater lateral to orifice



Phases of droplet formation

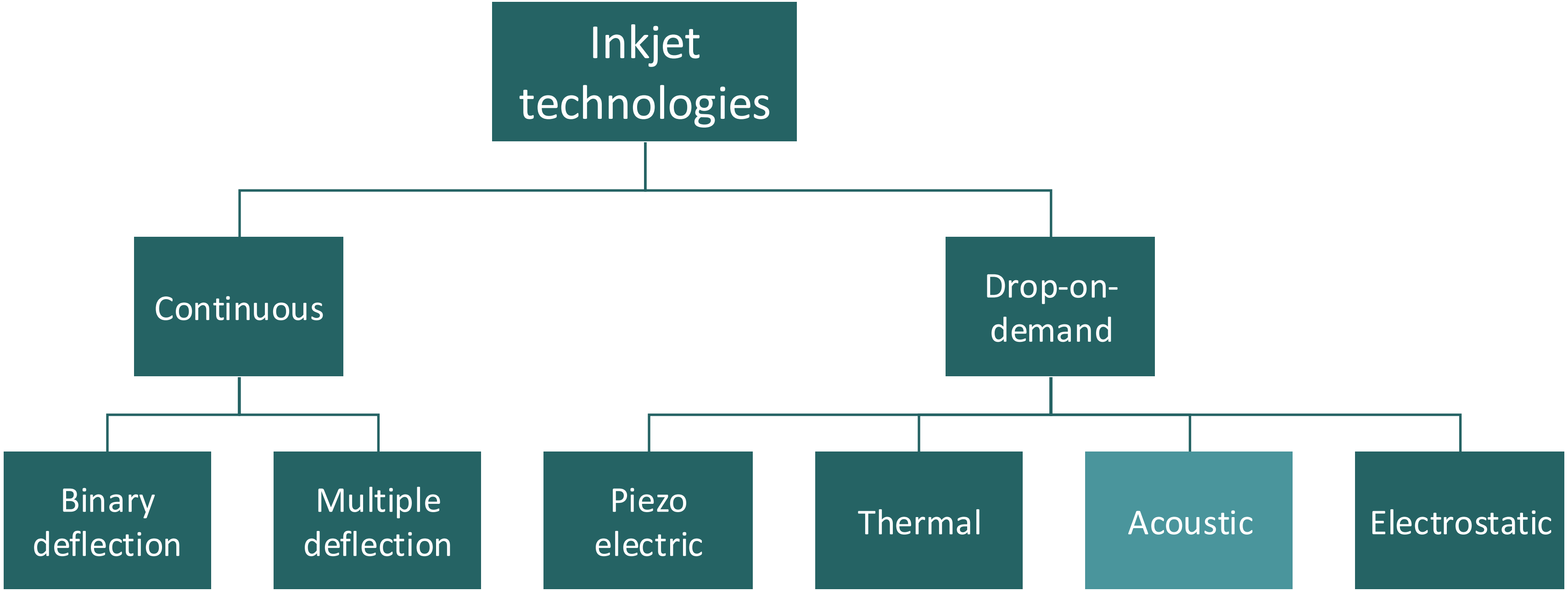
1. Heating for some µs
   - ✓ Overheated ink
   - ✓ At 300°C: nucleation of bubble
2. Expansion
   - ✓ Ejection of ink
   - ✓ Parallel to bubble expansion
3. Droplet formation
   - ✓ Collapsing vapor bubble
   - ✓ Retracting of bulk ink
   - ✓ Refilling of cavitx (80 – 200 µs)
   - ✓ Speed-critical step



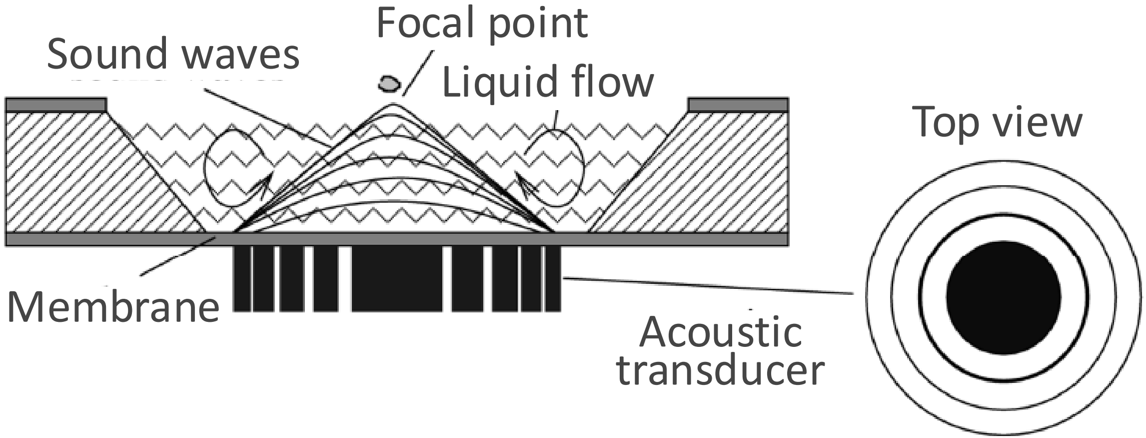
Summary thermal inkjet

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

Different techniques

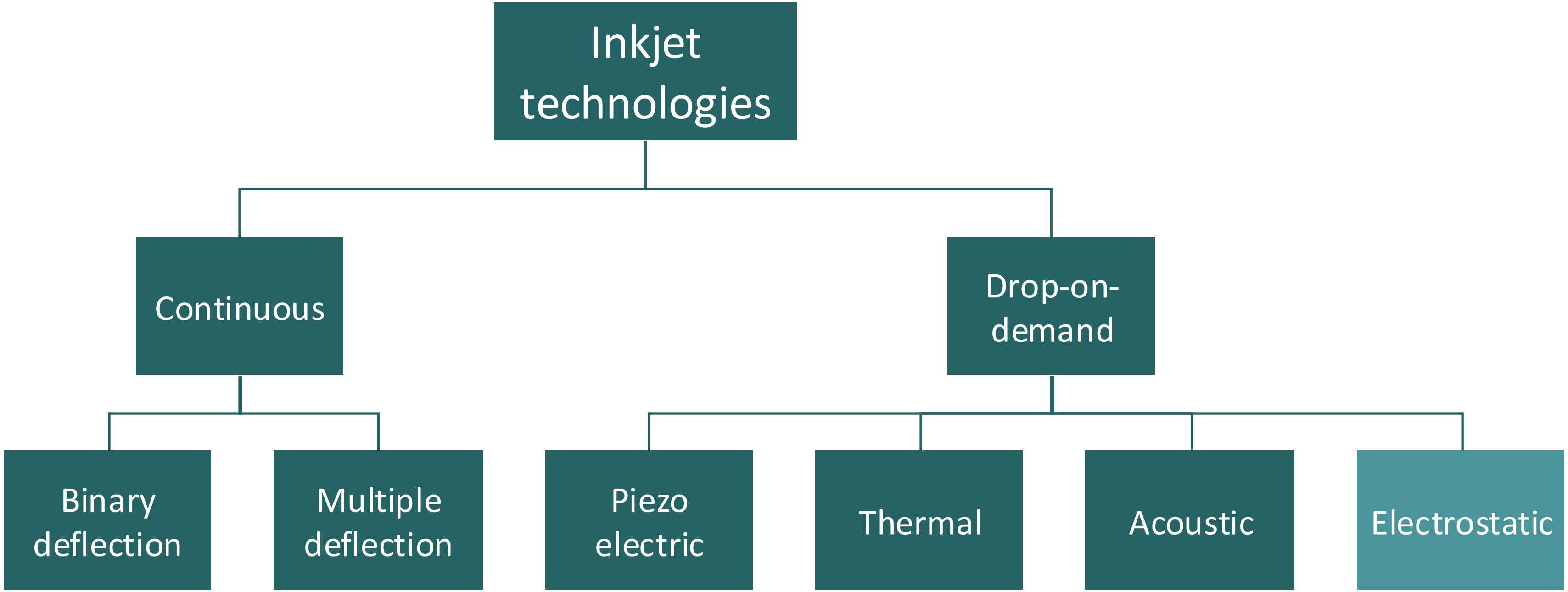


Ultrasonic droplet generation

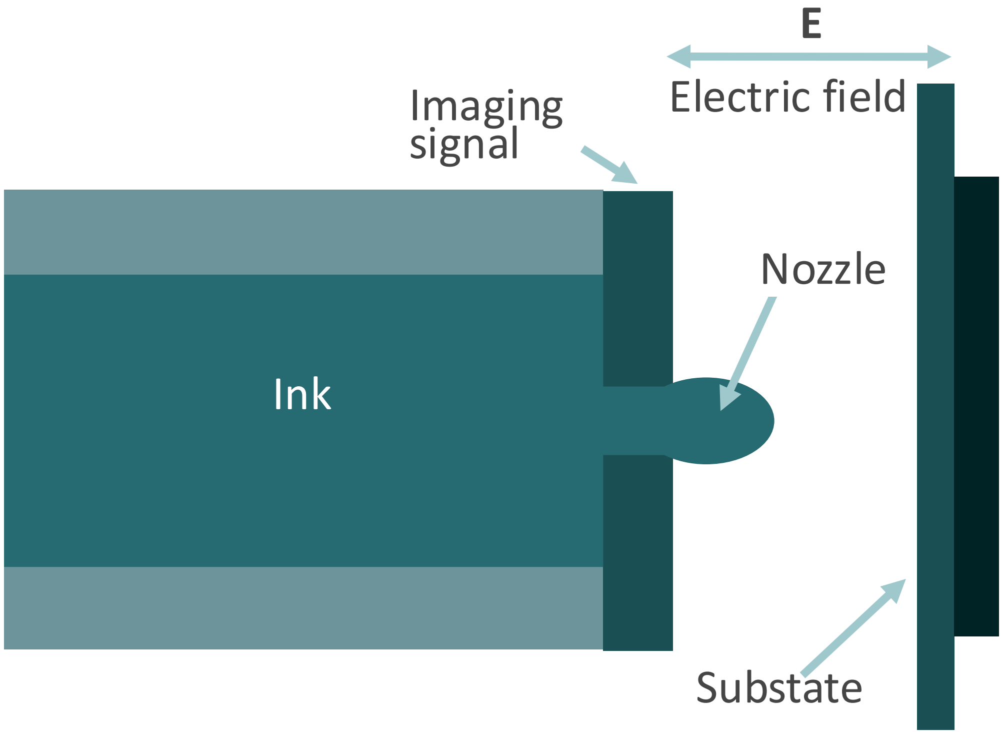


- ✓ Advantages
  - ✓ Low product cost
  - ✓ Large development and production investment
  - ✓ High nozzle density
- ✓ Disadvantages
  - ✓ Restricted ink types
  - ✓ Low duty cycles

Different techniques



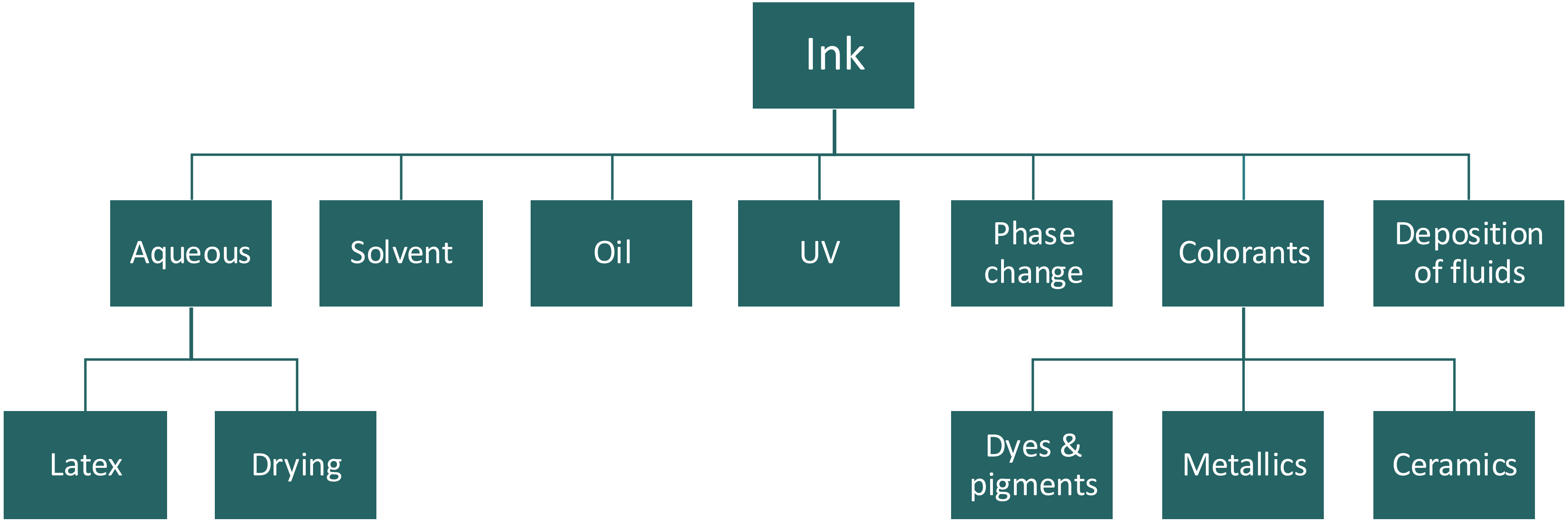
Electrostatic droplet generation



4.

Inks

Ink basis


Ink
Aqueous
Solvent
Oil
UV
Phase change
Colorants
Deposition of fluids
Latex
Drying
Dyes & pigments
Metallics
Ceramics

Coatema® Coating Machinery GmbH

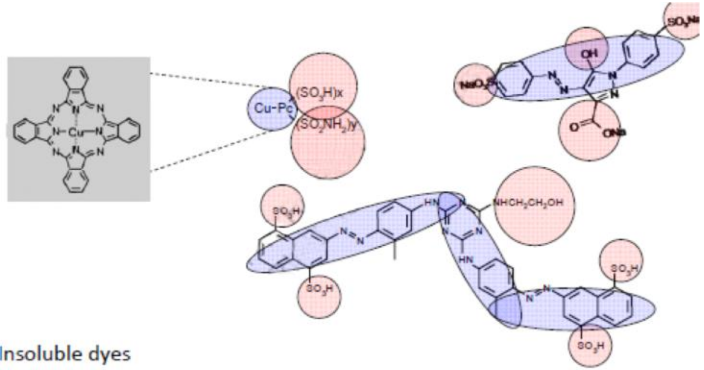
Colorants

- ✓ 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:
  - ✓ Maintaining dispersion
  - ✓ Achieving stable drop break-off
  - ✓ Nozzle mainetance
  - ✓ Drying speed vs. Robustnetts
- ✓ White inks usually based on TiO2, must be circulated to stay in suspension

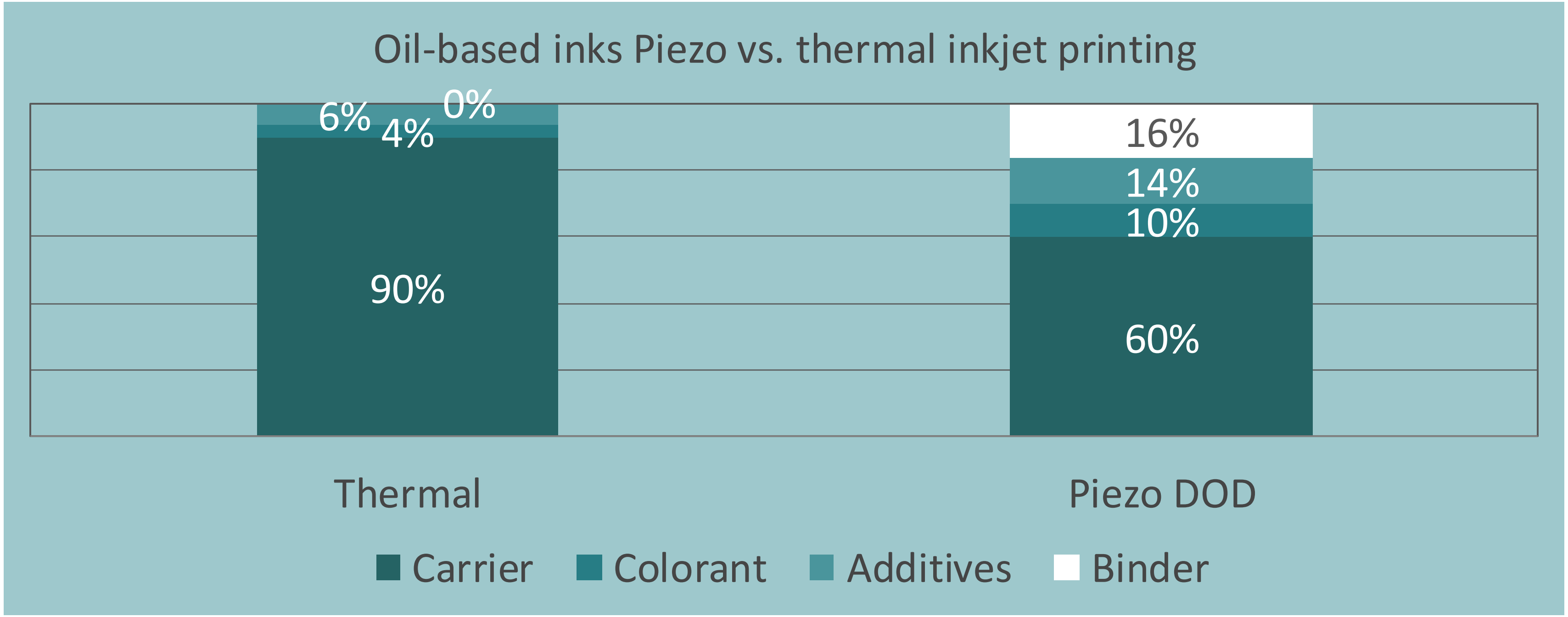


Insoluble dyes

Oil-based inks

- ✓ Used for some porous susbstrate 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
  - ✓ Limied use in shared wall technology due to need topassivat heads
  - ✓ New developments focused on non porous media applications
- ✓ Oil-based inks
  - ✓ Used in share 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
  - ✓ Extremly 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 ist jetting performance
  - ✓ i.e. anything that jets well will be useless in the process and vice versa
- ✓ For most applications, jetting perfomance 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 & adressing
  - ✓ Commercial printing
  - ✓ Textile printing
- ✓ Glycols added to reduce dyring 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 issus, image can take hours to lose odour
- ✓ Shipping & storages issus 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

Coatema® Coating Machinery GmbH

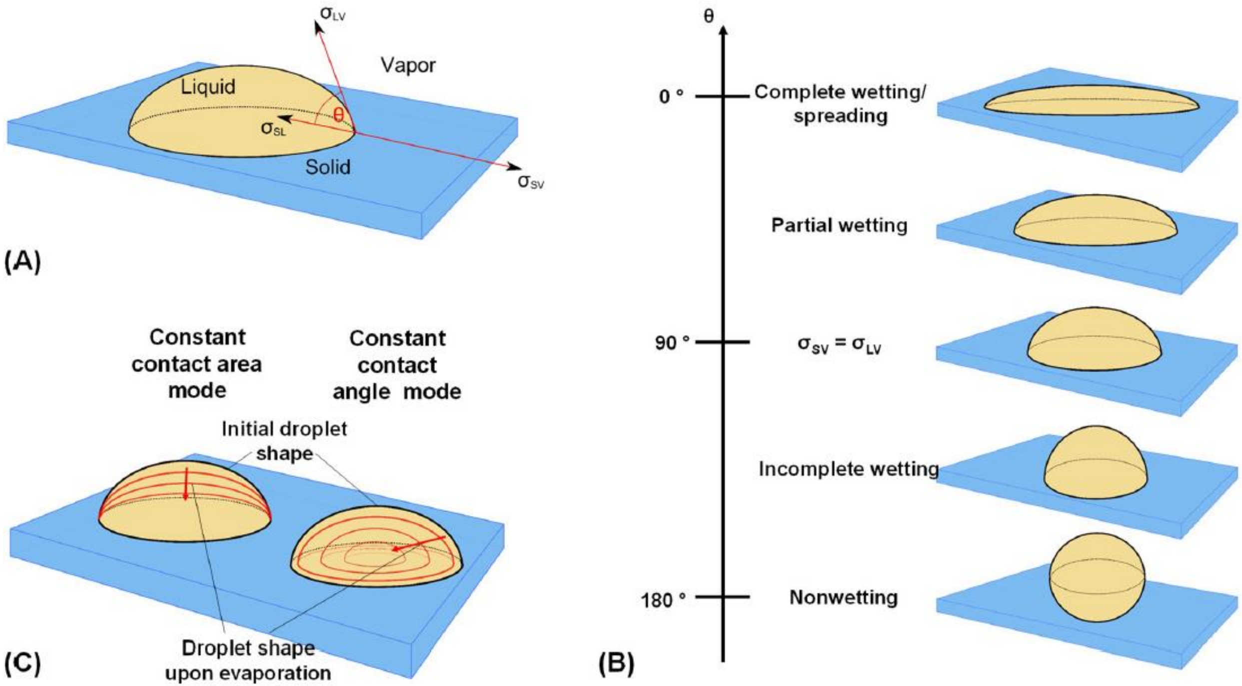
Inks specifications

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*

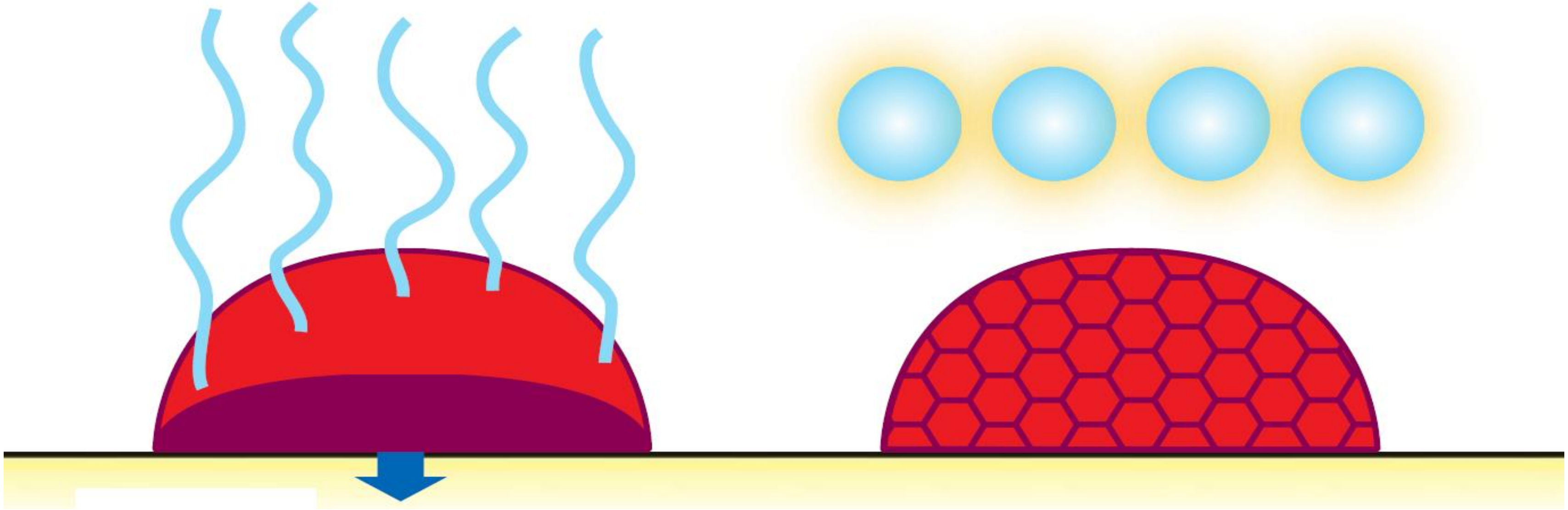
Requirements

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



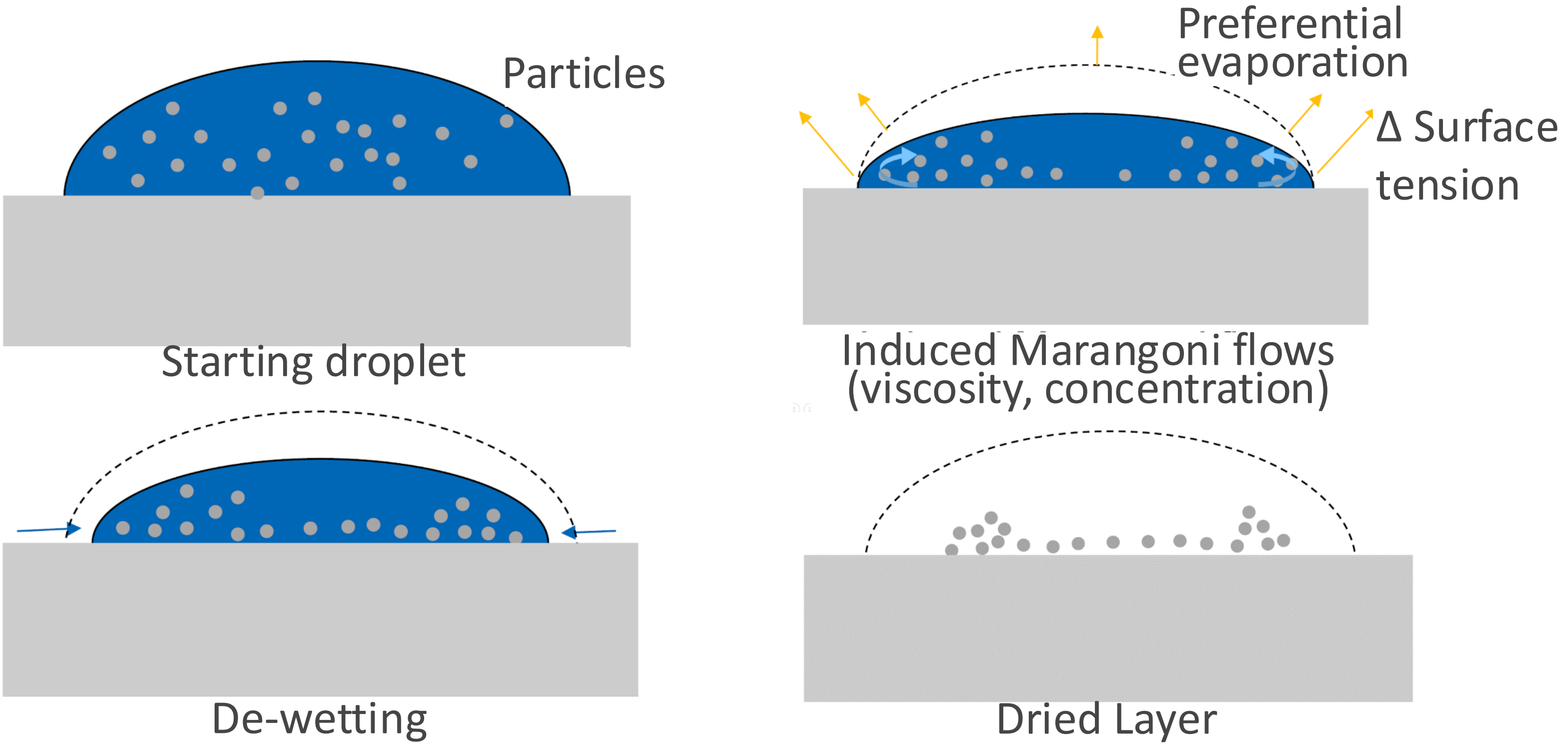
Drying & curing



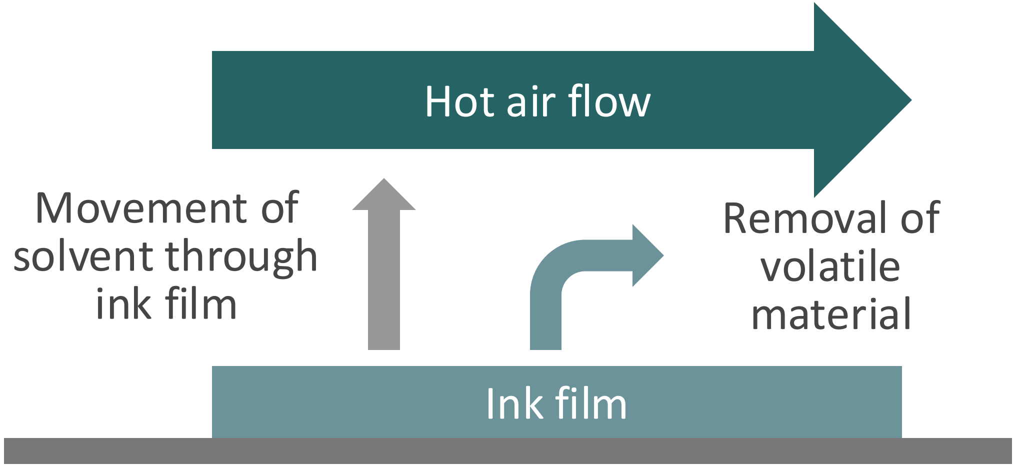
Drying: ✓ Water based ✓ Solvent based

Curing: ✓ UV ✓ EB

Droplet evaporation



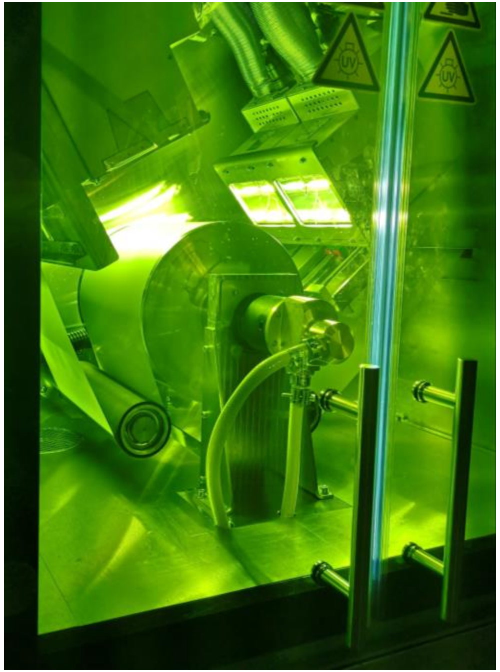
Evaporation



- ✓ 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

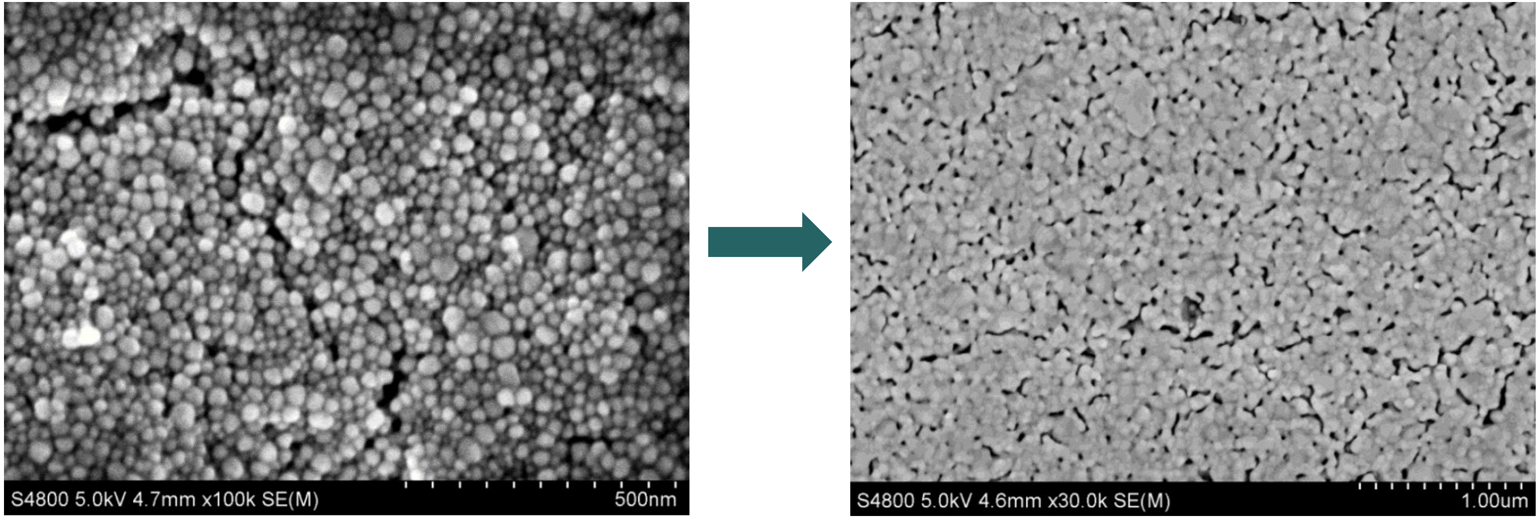
UV-curing systems

- ✓ 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

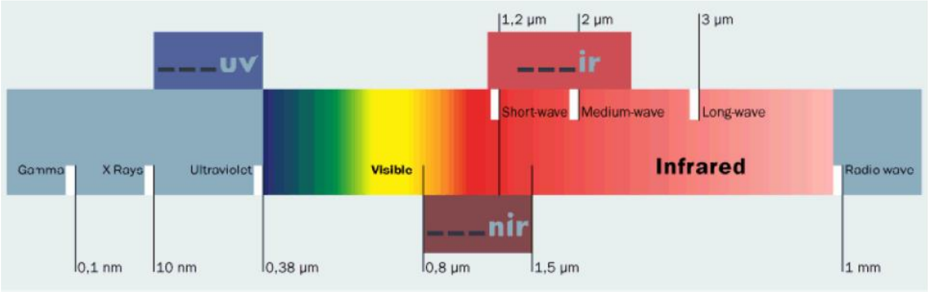


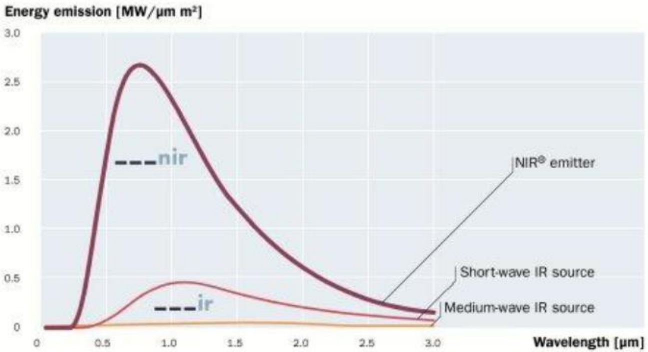
Silver nano-particle sintering

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



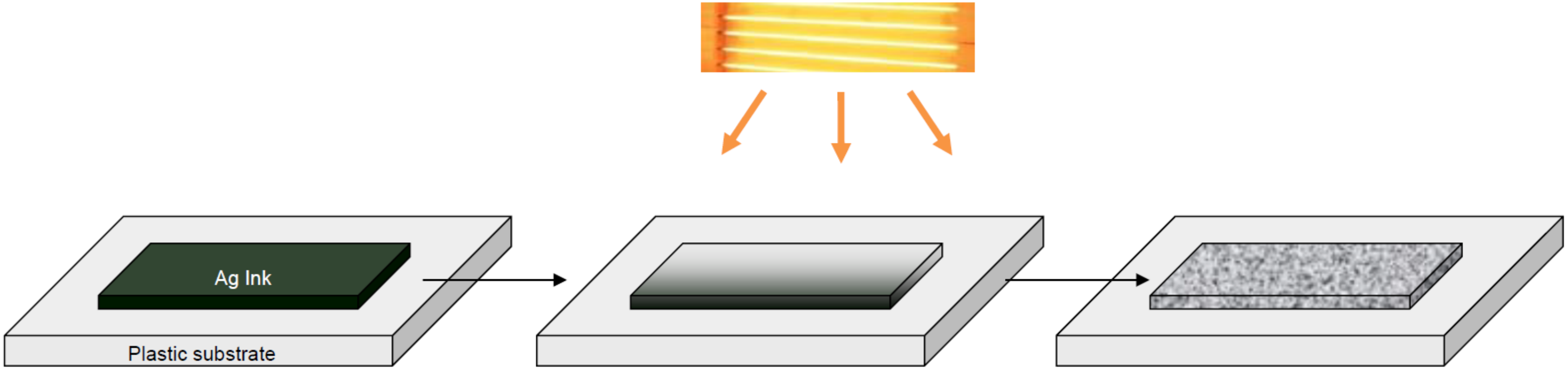
Near infrared in the EM spectrum





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

5.

Printheads

Overview inkjet

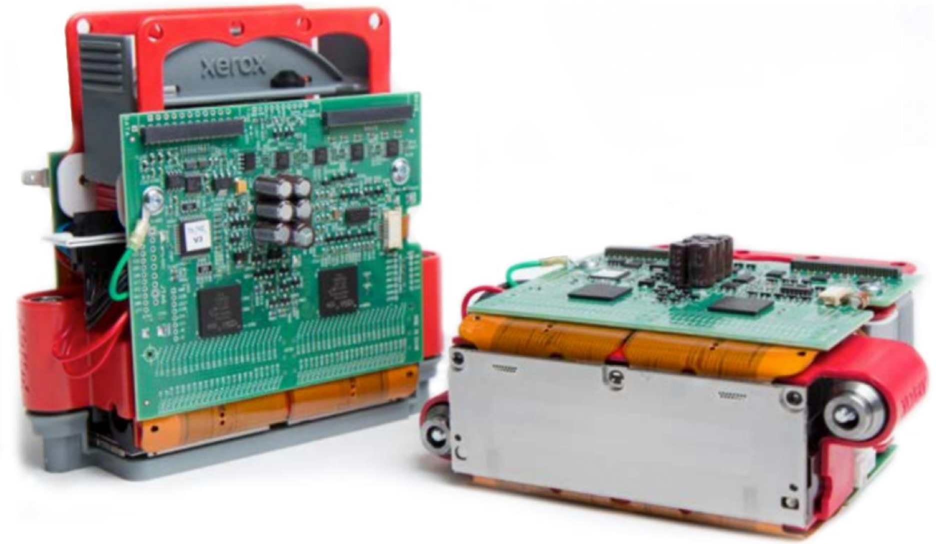
- Inkjet Print Heads Technologies
  - Drop on Demand (DOD)
    - Piezo (PIJ)
      - Fujifilm Dimatix
      - Sharp
      - Domino
      - Brother
      - Videojet Marsh
      - Epson
      - Ricoh
      - Trident
      - Kyocera
      - HP Aprion, X2
      - Xaar
      - Toshiba-tec
      - Panasonic
      - Seiko II
      - Samsung
      - KonicaMinolta
      - PicoJet/NextJet ix)
    - Thermal (TIJ)
      - Canon
      - HP
      - Lexmark
      - Kodak
      - Olivetti
      - Xerox
      - Silverbrook Memjet
    - Electrostatic
      - TTP-ToneJet
      - NEC
      - Tokyo Elecrtic
      - Matsushita
    - ValveJet
      - Milliken
      - Zimmer
      - Foxjet
      - Domino
      - Videojet Printos
      - Imaje Crayon
      - Loveshaw
      - Kortho
  - Continuous
    - Binary
      - Stork
      - Scitex Iris
      - Siemens
      - Domino
      - Kodak Versamark
    - Multi-level
      - VideoJet Danather
      - Imaje Dover
      - Jemtex
      - Linx
      - Willet

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 greyscales 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

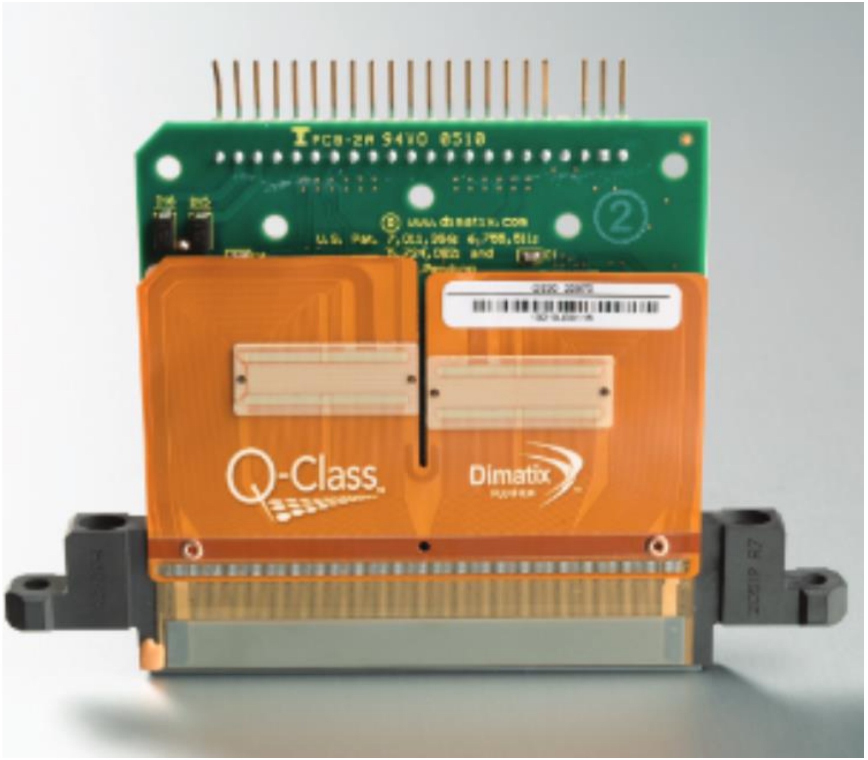


Fujifilm Dimatix

- ✓ 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 VersaDropTM 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 specifiy fluids

Source: Fujifilm USA

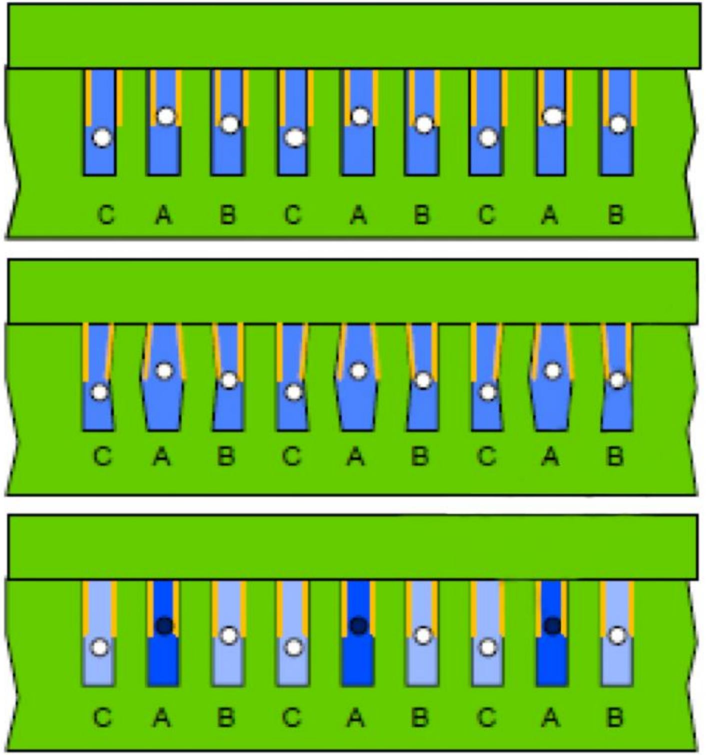
Fujifilm Samba printhead

- ✓ 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 lage arrays

Source: Fujifilm USA

Xaar

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



Source: Fujifilm USA

Xaar

- ✓ 1 000 Nozzles
- ✓ Print wath 70.5 mm
- ✓ Horizontal or vertical orientation
- ✓ 360 nozzles/inch
- ✓ 6 m/s drop verloxite
- ✓ 7 – 50 cP viscositx 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

6.

Our status

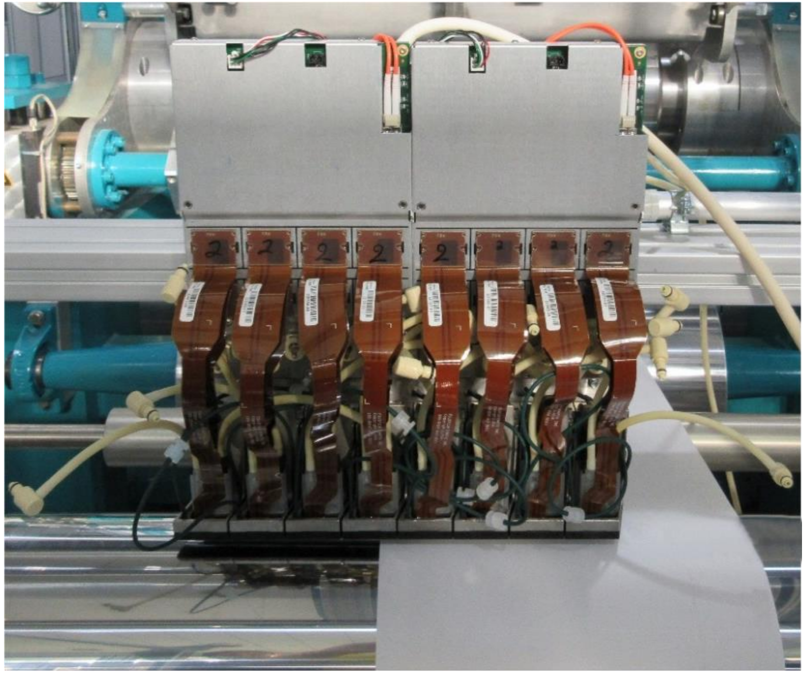
Inkjet process parameter

Coating chemistry	Inkjet processes	Print head control	Drying
✓ Rheology ✓ Viscosity ✓ Ink or fluid ✓ Type of solvents ✓ Amount of solids ✓ Size of particles ✓ Sheer ratio ✓ Adhesion/Cohesion	✓ Print heads ✓ Ink delivery ✓ Color control ✓ Droplet control ✓ Substrate speed ✓ Layer thickness ✓ Printing accuracy	✓ Registration ✓ Print head controller electronic ✓ Material guiding system ✓ Inline parameter control ✓ Firmware ✓ Image convertion software	✓ Convection drying ✓ Contact drying ✓ Infrared drying ✓ Sintering ✓ NIR ✓ High frequency ✓ UV crosslinking systems

Substrate	Pretreatment	Environment	Finishing
✓ Surface tension ✓ Dimension stability ✓ Surface structure ✓ Contact angle	✓ Corona ✓ Plasma ✓ Cleaning	✓ Humidity ✓ Temperature ✓ Inert conditions	✓ Calendaring ✓ Embossing ✓ Slitting

Integration of the „inking“ system – current status

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

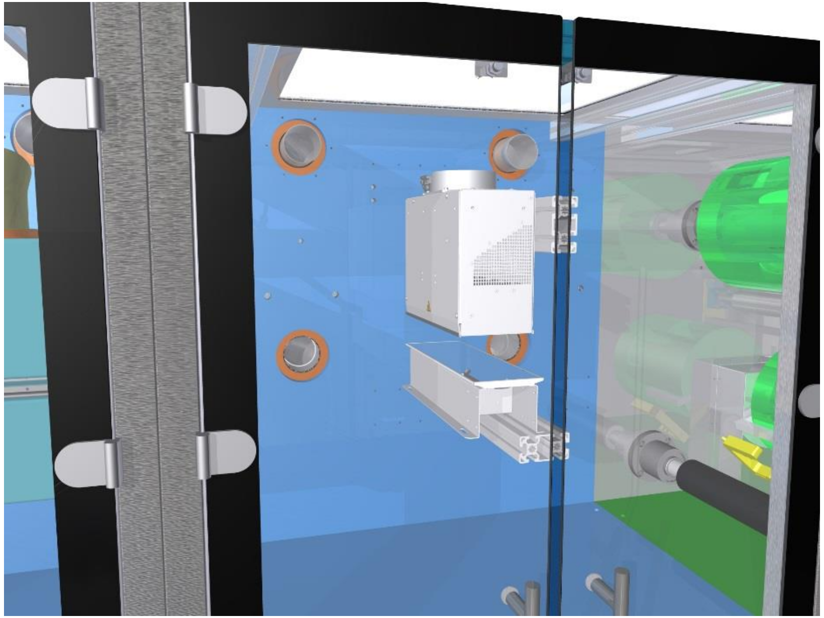


Integration of analysis and sintering units – current status

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

Unit layout

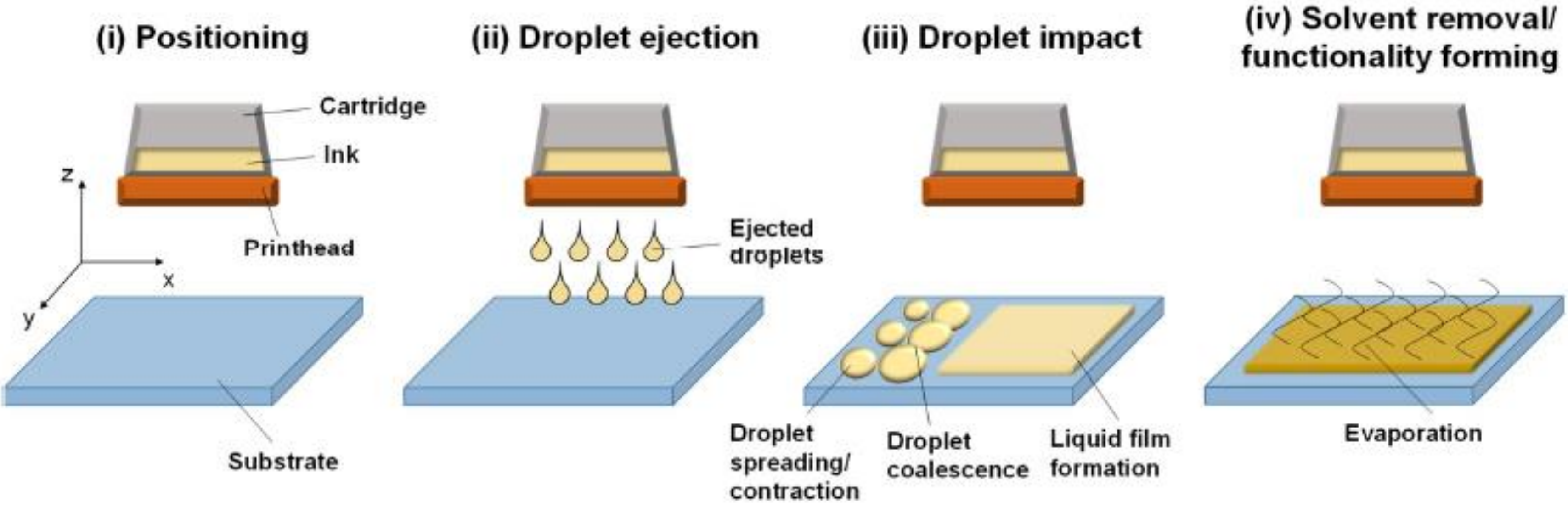
Unit layout



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

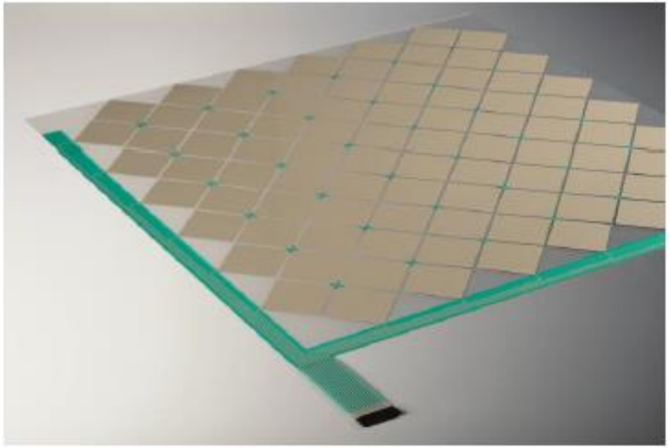
Status

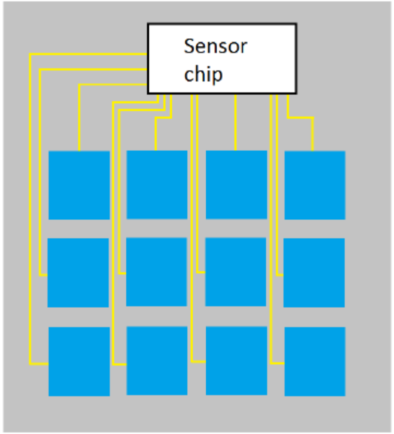


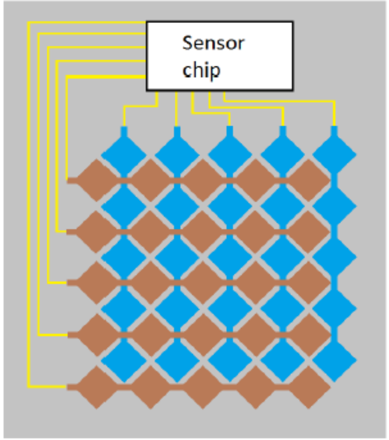
(i) Positioning
(ii) Droplet ejection
(iii) Droplet impact
(iv) Solvent removal/ functionality forming
Cartridge
Ink
Printhead
z
x
y
Substrate
Ejected droplets
Droplet spreading/ contraction
Droplet coalescence
Liquid film formation
Evaporation

Coatema®
Coating Machinery GmbH

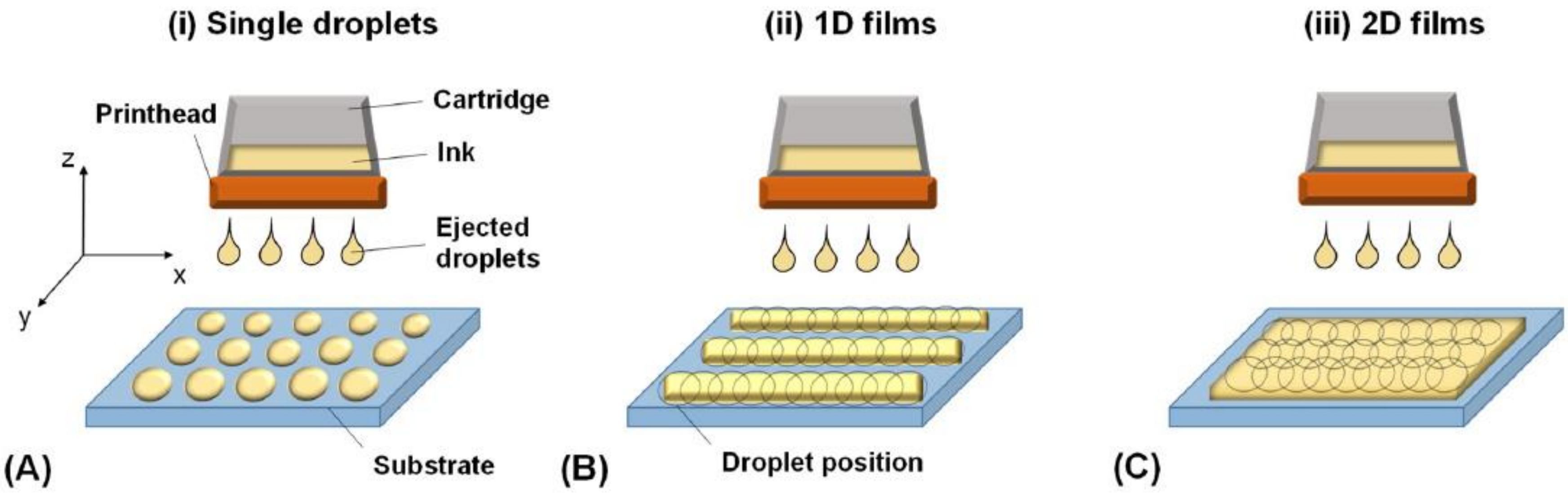
Status



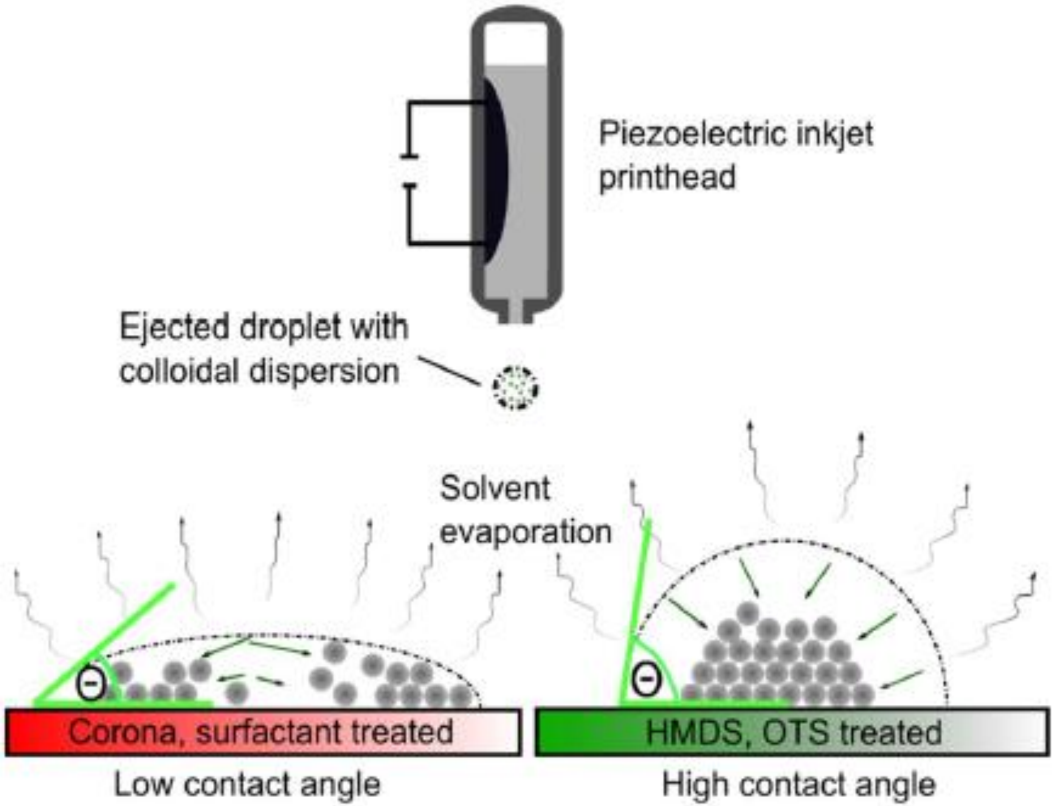




Status


(i) Single droplets
(ii) 1D films
(iii) 2D films
Printhead
Cartridge
Ink
Ejected droplets
z
x
y
Substrate
Droplet position
(A)
(B)
(C)

Status



Piezoelectric inkjet printhead
Ejected droplet with colloidal dispersion
Solvent evaporation
Corona, surfactant treated
Low contact angle
HMDS, OTS treated
High contact angle

8.

Summary

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

Download broschures & presentations

Thank you

Roseller Straße 4 ▪ 41539 Dormagen ▪ Germany
T +49 21 33 97 84 - 0 ▪ info@coatema.de

www.coatema.com

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