



CORPORATE PRESENTATION

October 2015



nanoSaar AG Management Team



Dr. Michael Steiner - CEO

More than 30 years of international experience in the chemical, consumer and healthcare industries

Ph.D. in biochemistry at the Max-Planck-Institute in Martinsried/ Munich

Managing Partner with JSB-Partners, Boston/Munich

Management consulting positions as senior partner and global healthcare practice group leader of Bain & Company, New York and The Boston Consulting Group, Munich/Boston

Co-Founder of the venture capital company MPM Capital in Boston/ San Francisco



Dr. Stefan Hagemann - CFO

More than 25 years of international business experience in management consulting (The Boston Consulting Group, Munich), private equity (Alchemy Partners, Frankfurt/London), venture capital (TTM Investor, Bonn/Munich) and hedge fund management (Euvestor AG, Munich)

Focus on business development, M&A, finance and IPOs in all kinds of industries

Various CFO, executive & supervisory board positions in many portfolio companies

Team of MJR Nano Specialists



Hermann Schirra

Managing Director of nanoSaar Lab GmbH

More than 20 years of nano experience in the nanotechnology industry

R&D positions at Leibniz-Institute for New Materials, Saarbrücken and various companies

Founder of Sarastro GmbH

Focus on product development for industrial, medical, medical device, pharmaceutical und food & beverage applications

Within his career, he was awarded several times



Dr. Bernd Baumstümmler

CEO and founder of MJR PharmJet GmbH, Homburg

25 years of experience in the international pharmaceutical and biotech industries

Expert in biotechnology, process optimization, project management, business development

Senior Project Manager for technology and biotech companies with Mediport Venture Capital Management GmbH, Berlin

Several consulting and management positions as a CFO



Dr. Akif Emre Türeli

Chief Scientific Officer MJR Pharmjet GmbH, Homburg

More than 10 years of international R&D experience in the nanotechnology industry

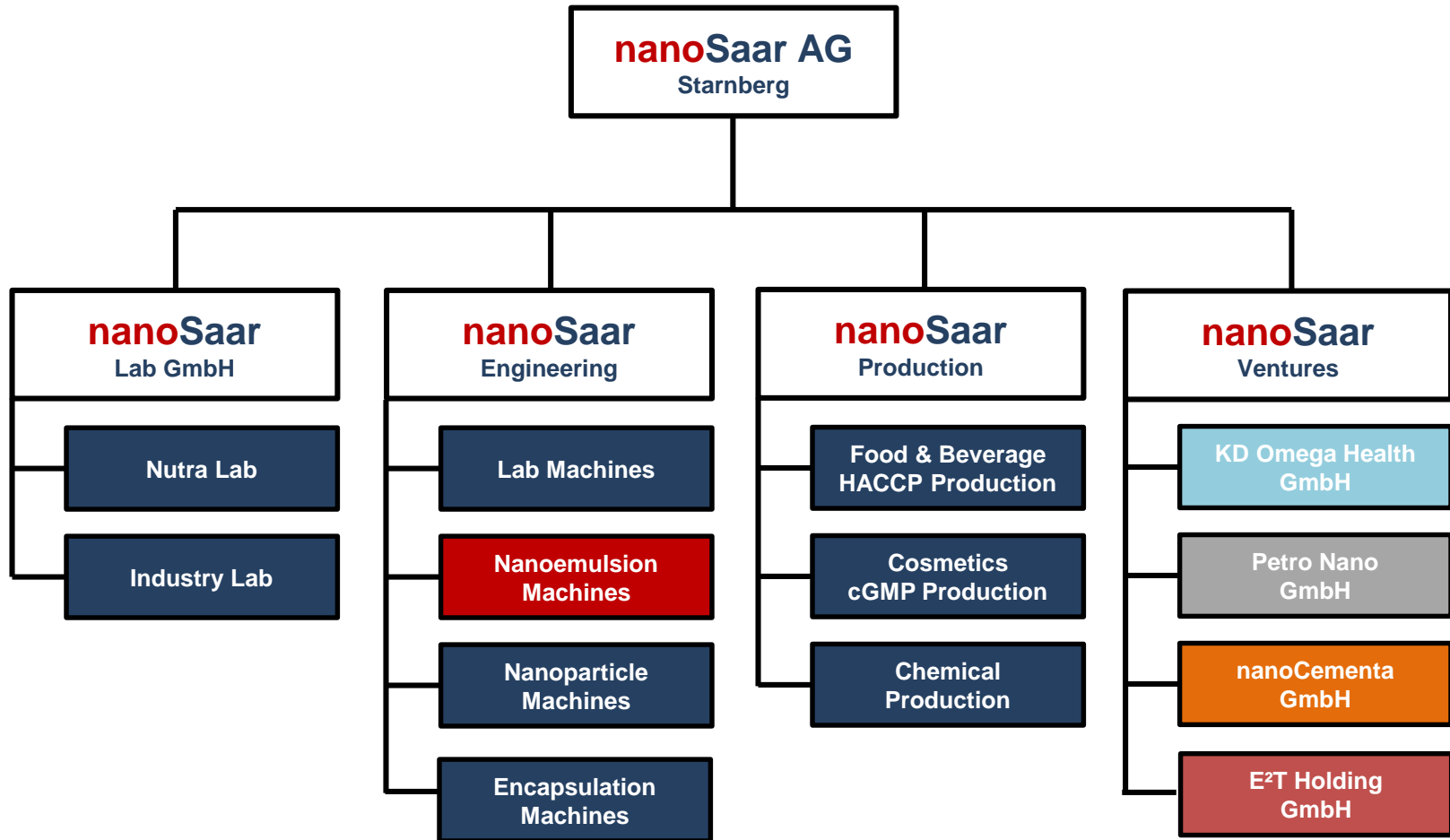
R&D positions in various pharma companies (Abdi Ibrahim Pharmaceuticals, Istanbul/ Across Barriers GmbH, Saarbrücken/ Phast GmbH, Homburg/ MJR Pharmjet GmbH, Homburg)

Focus on development of innovative formulations using the MJR nanotechnology for different industry applications

Our Strategy

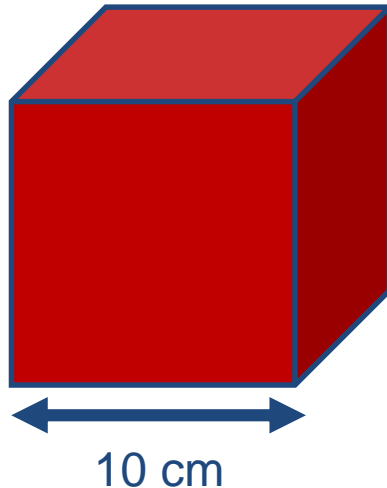
- nanoSaar AG is the exclusive license owner of the patented MJR nanotechnology.
- The MJR technology can produce nano-/microparticles, emulsions and encapsulations with a highly defined size. Our MJR-Technology creates superior results compared to spray drying, milling, high pressure homogenization and other technologies.
- The continuous low cost production process allows for an almost unlimited industrial scale up.
- We offer to our customers product development services and build up of MJR production capacity at the customer site.
- We offer in-house production services with proprietary products.
- We offer common new business development for nano applications in licensing and joint venture models.
- Our business approach is to commercialize our proprietary economic MJR production capabilities in the following industries: Nutrition, Food & Beverage, Cosmetics, Consumer Products, Flavors & Fragrances, Animal Health, Crop Science, (Petro)-Chemistry, Biocides, Catalyzers, Paints/Coatings, Construction, Electronics, Water Purification.

Our Business Areas



Why are Nanoparticles Different ?

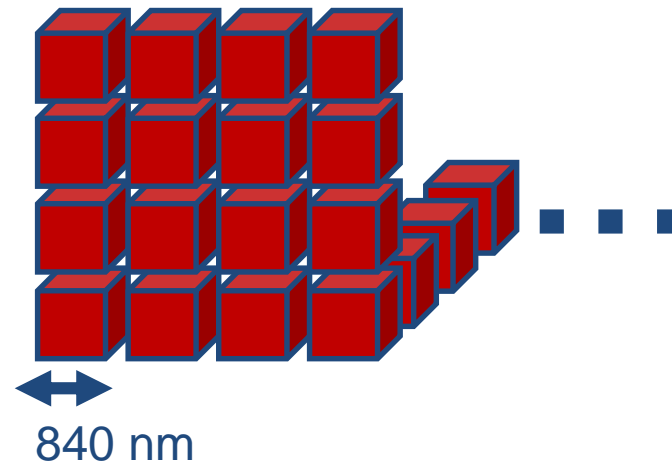
1 kg of a substance:



Surface of cube: **600 cm²**

For comparison:
DIN A4 sheet of 21 x 29,7 cm
Area: 623,7 cm²

1 kg of a substance:

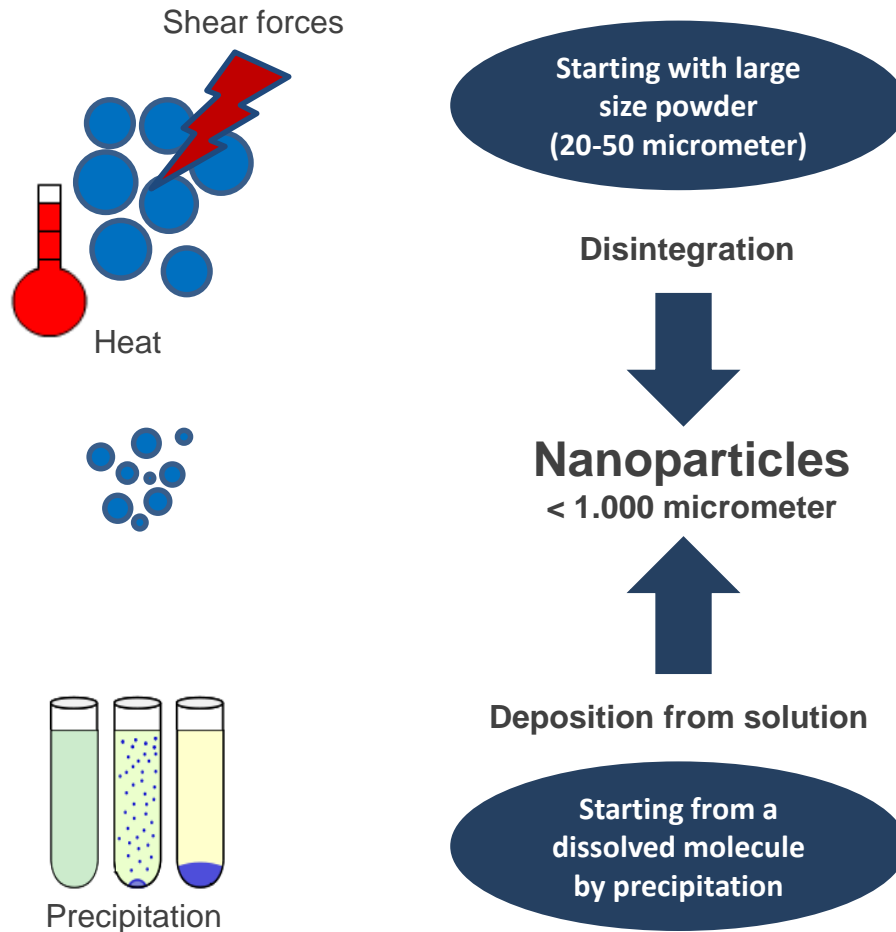


Surface of all „nano“ cubes: **7140 m²**

$1,69 \cdot 10^{15}$ „nano“-cubes fit inside

For comparison:
Soccer field of 68 x 105 m
Area: 7140 m²

Principles of Nanoparticle Manufacturing



Top-Down Process

Colloidal Mills



Bottom-Up Process

Micro Jet Reactor



25 Years Development For the MJR Technology



**MJR-Reactor
Patent**

**Pharma, Food, Cosmetic
MJR Patent**

● **Synthesechemie**

- Founded in Saarbrücken by Dr. Penth
- Invention of **MicroJet Reactor**
- Production of worldwide smallest BaSO₄ Particles
- Ceramic Membrane serving as Separator in Li-Ion Batteries, licensed exclusively to Degussa's Separion

2002 „Anerkennungspreis Ruhrgebiet“

2004 „Degussa Innovation Award“

2007 Nomination for „Deutscher Zukunftspreis des Bundespräsidenten“

2009 „Ruhr2030Award“
2009 International Environmental Award „Öko-Globe“ (Evonik, Daimler Benz)

● **MJR Pharmjet GmbH (2010)**
Laboratory

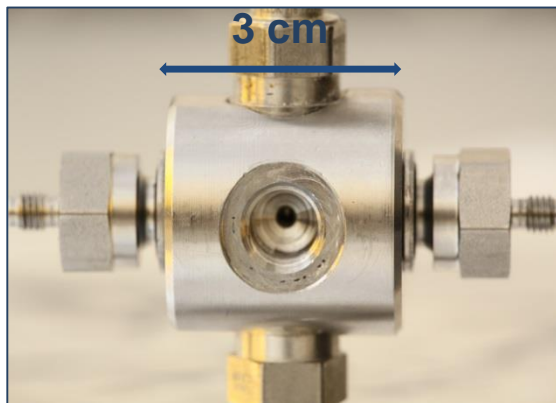
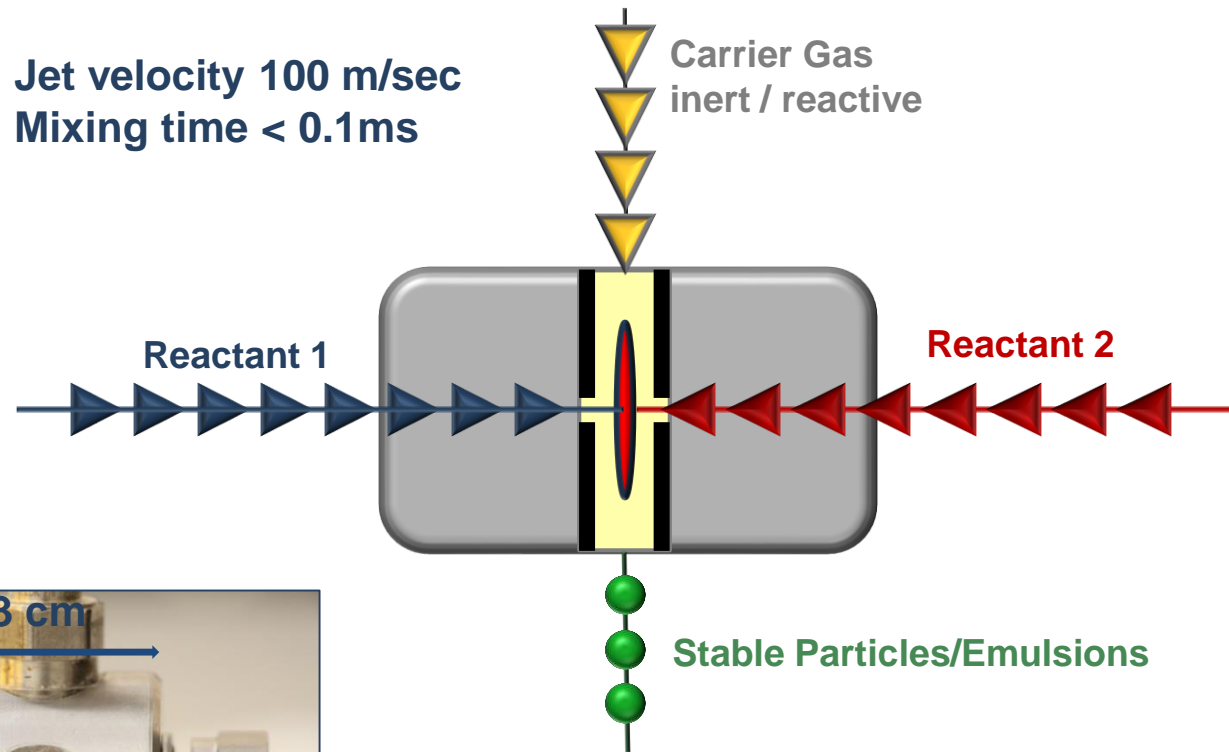
● **leon nanodrugs GmbH (2011)**
Contract Development
Nanopharmaceuticals

● **nanoSaar AG (2013)**
Outlicensing of MJR technology
in all industries outside pharma

Very Strong MJR Patent Platform

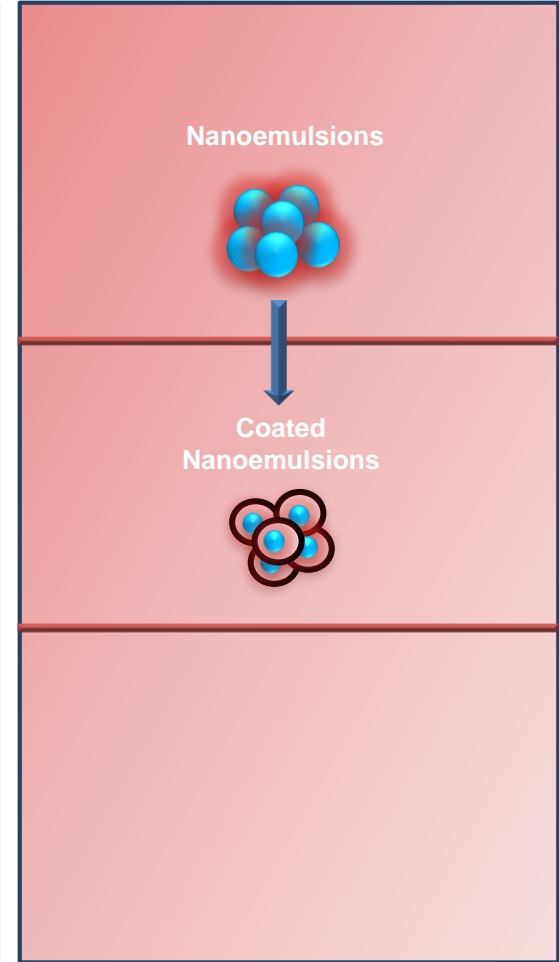
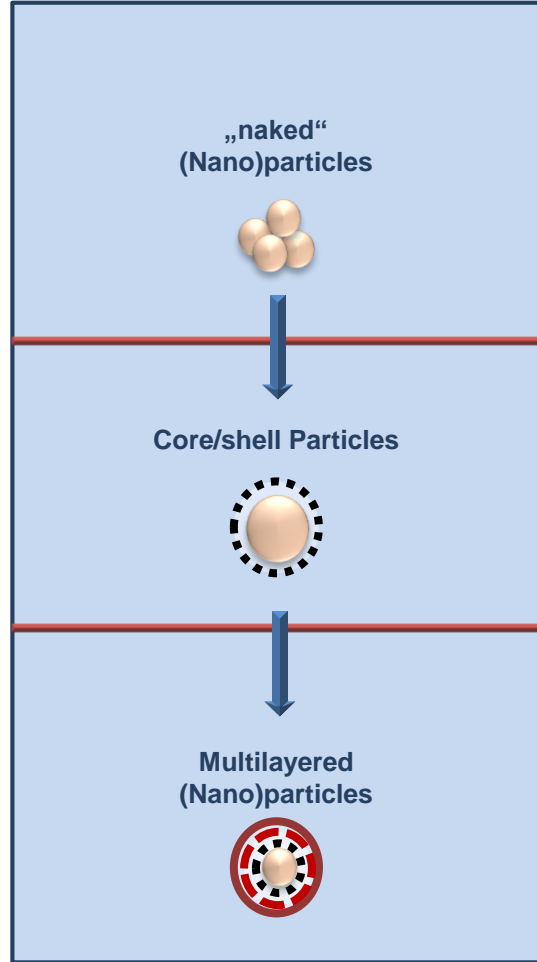
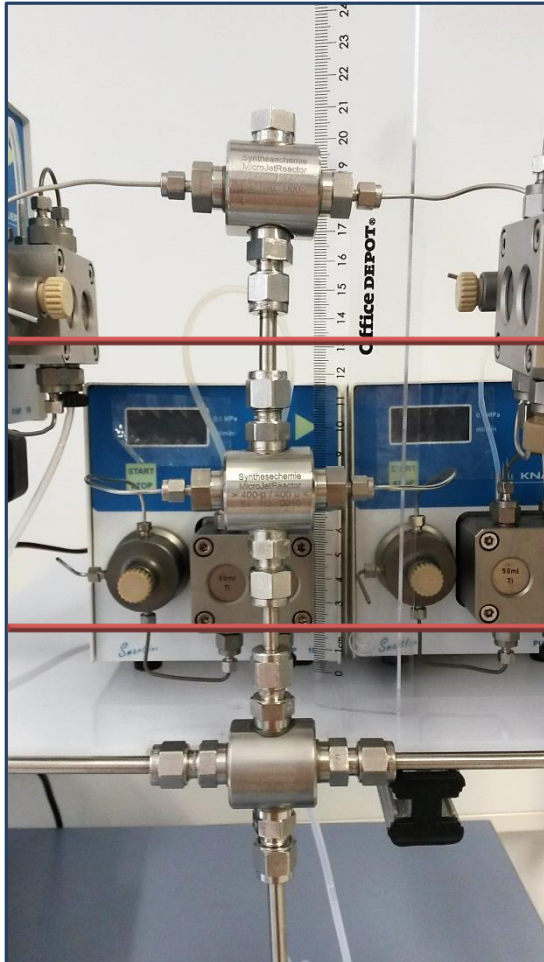
	Patent number	Filing Date	Publication Date	Priority date	Applicant	Patent holder	Title	Status	Expiry
1	EP 1165224 B1	07.04.2000	18.09.2002	08.04.1999	Bernd Penth	Bernd Penth	Verfahren und Vorrichtung zur Durchführung chemischer und physikalischer Reaktionen	granted	
	PCT/DE00/01061 A3 (continuation of EP 1165224 B1)	07.04.2000	19.10.2000	08.04.1999	Bernd Penth	Bernd Penth	Method And Device For Carrying Out Chemical And Physical Processes	Positive ISR	
2	PCT/DE/2010/075015 = WO 2010/091683 A3 (continuation of national patent P 10 2009 008478.9)	11.02.2010	19.08.2010	11.02.2009	MJR PharmJet GmbH	Instillo GmbH	Device and method for producing pharmaceutically highly refined particles and for coating said particles in microreactors	Positive ISR	
	US8697131							Granted (15.04.2014)	29.08.2030
	CN2,751,625					Instillo GmbH		GrantedS	
3	PCT/DE2011/075044 = WO 2011/116763 A1 (continuation of national patent P 10 2010 010996.7)	21.03.2011	29.09.2011	22.03.2010	MJR PharmJet GmbH	Instillo GmbH	Method and apparatus for the production of size controlled Micro- and Nanoparticles of water soluble and water insoluble substances through controlled precipitation, Coprecipitation and self organisation processes in microreactors	Positive ISR	
	NZ602674							Granted (28.01.2014)	31.03.2031
	AU2011232103							Granted (06.02.2014)	
	SA 2012/06810							Granted (29.05.2013)	
	US 8,852,644						Granted (01.10.2014)		

Our MJR MicroJet-Reactor Technology



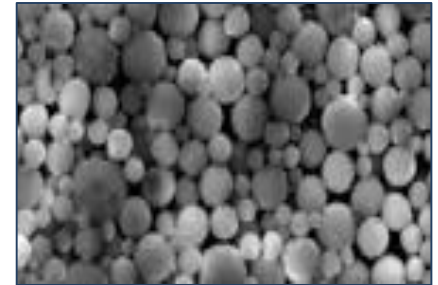
1. Continuous precipitation
2. One-step reaction
3. Parallelization and Serialization

From Simple Particles to Complex Shell Systems

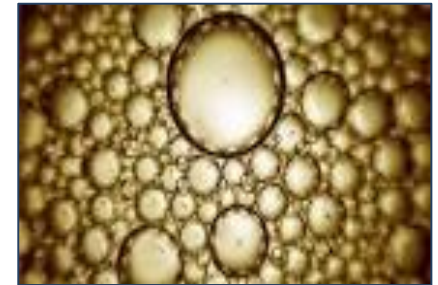


MJR Suitable for 3 Technological Areas

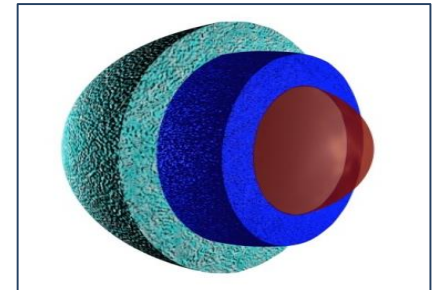
- **Nanoparticles** for filling materials, additives and chemicals (e.g. insoluble metal salts, biocides, metal oxides)



- **Emulsions**: Improvement of color, texture and uniformity with micron and submicron emulsions (e.g. flavor & fragrance oils, waxes)



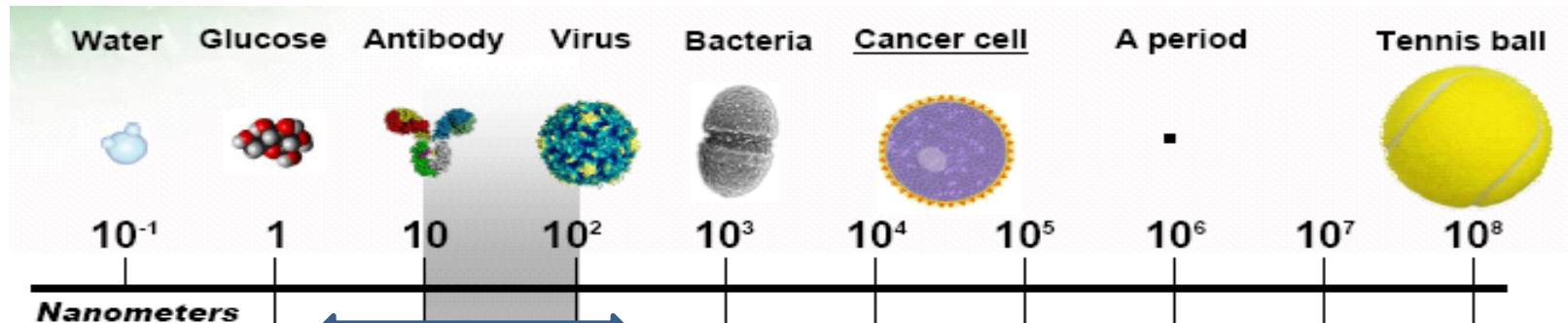
- **Encapsulation**: Ingredient stability, taste masking, dispersibility through nano/micro encapsulations (e.g. pigments, vitamins, omega-3, fragrances, pesticides)



Particle Size is Crucial

EC Commission definition of nano particles (EFSA guideline)

- any external dimension of a substance between 1 and 100 nm
- with >50% of the particles having such a dimension



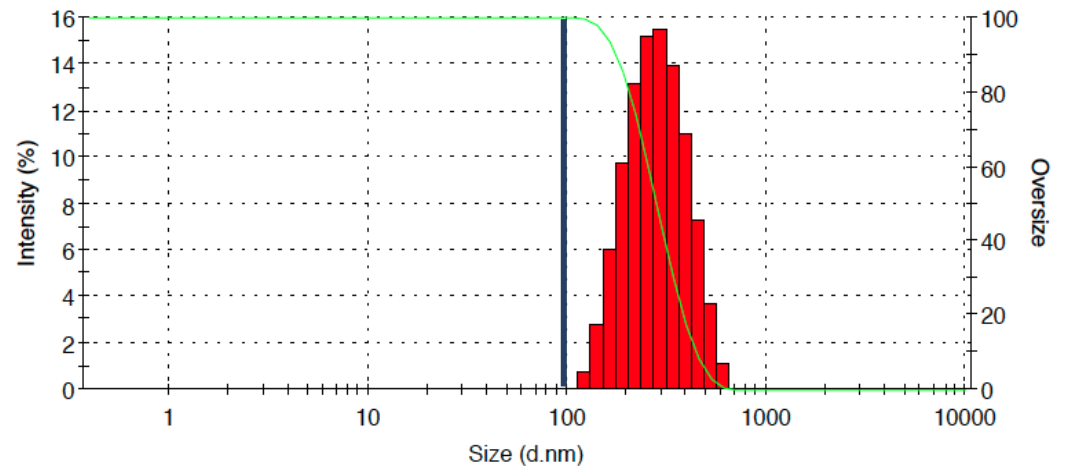
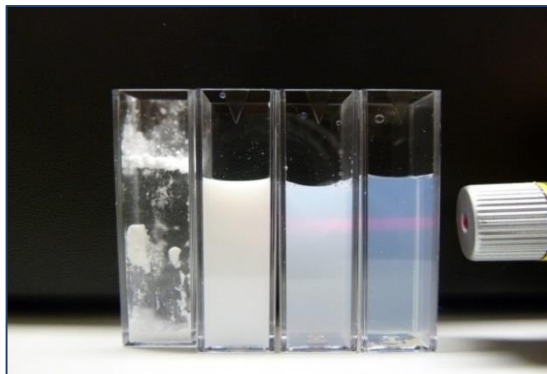
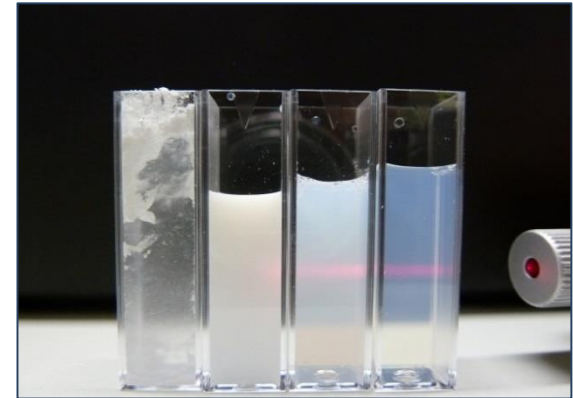
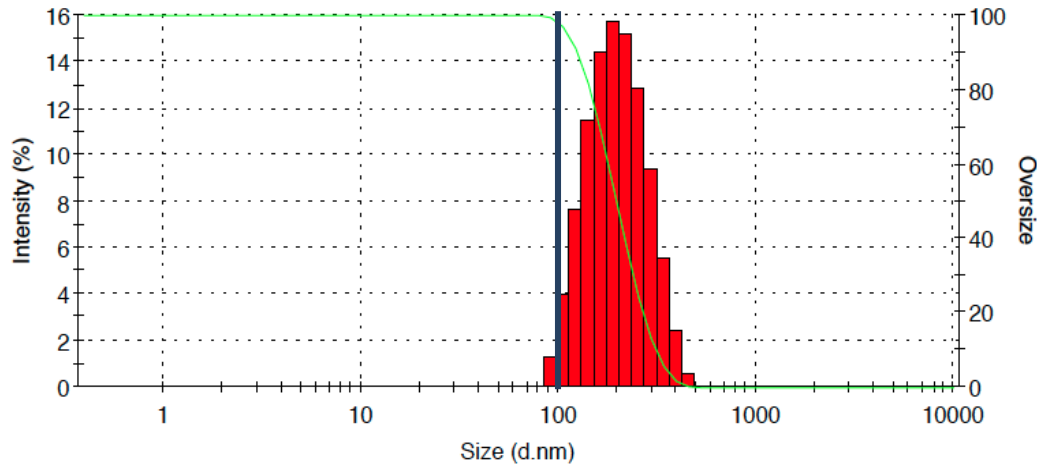
Pharma, Chemicals

- Nano particles desired
- Benefit: better absorption
- Ideal size 5nm – 1000nm

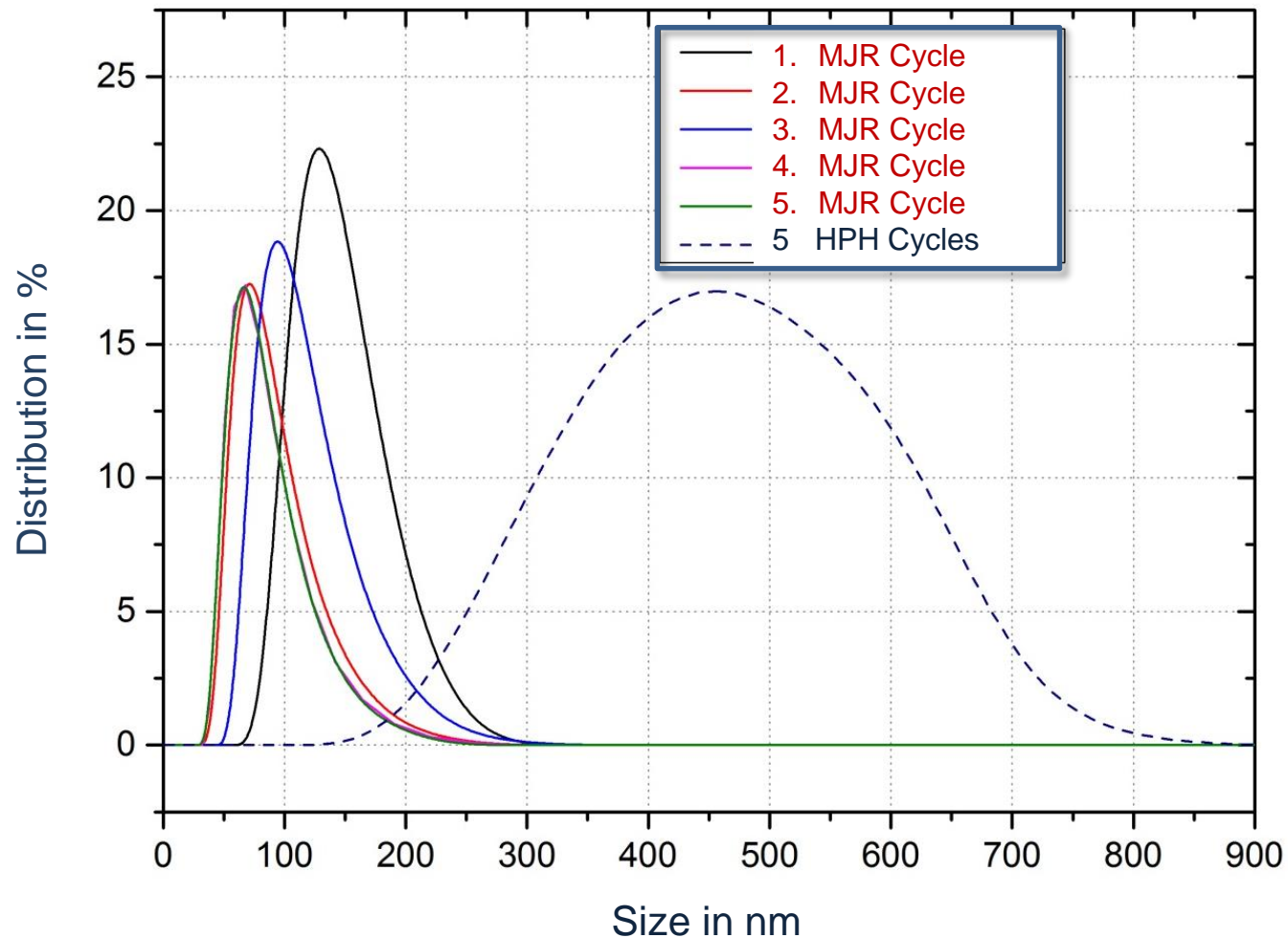
Flavors & Fragrances, Food, Cosmetics

- Nano particles avoided
- Benefit: controlled release, masking, protection
- Ideal primary particle size 200nm – 100 μ m
- Secondary agglomerates 100 μ m – 500 μ m

Particle Size Can be Adjusted with MJR Reactor



MJR Versus High Pressure Homogenization



From Lab Scale to Production Scale



MJR Reactor for R&D Lab



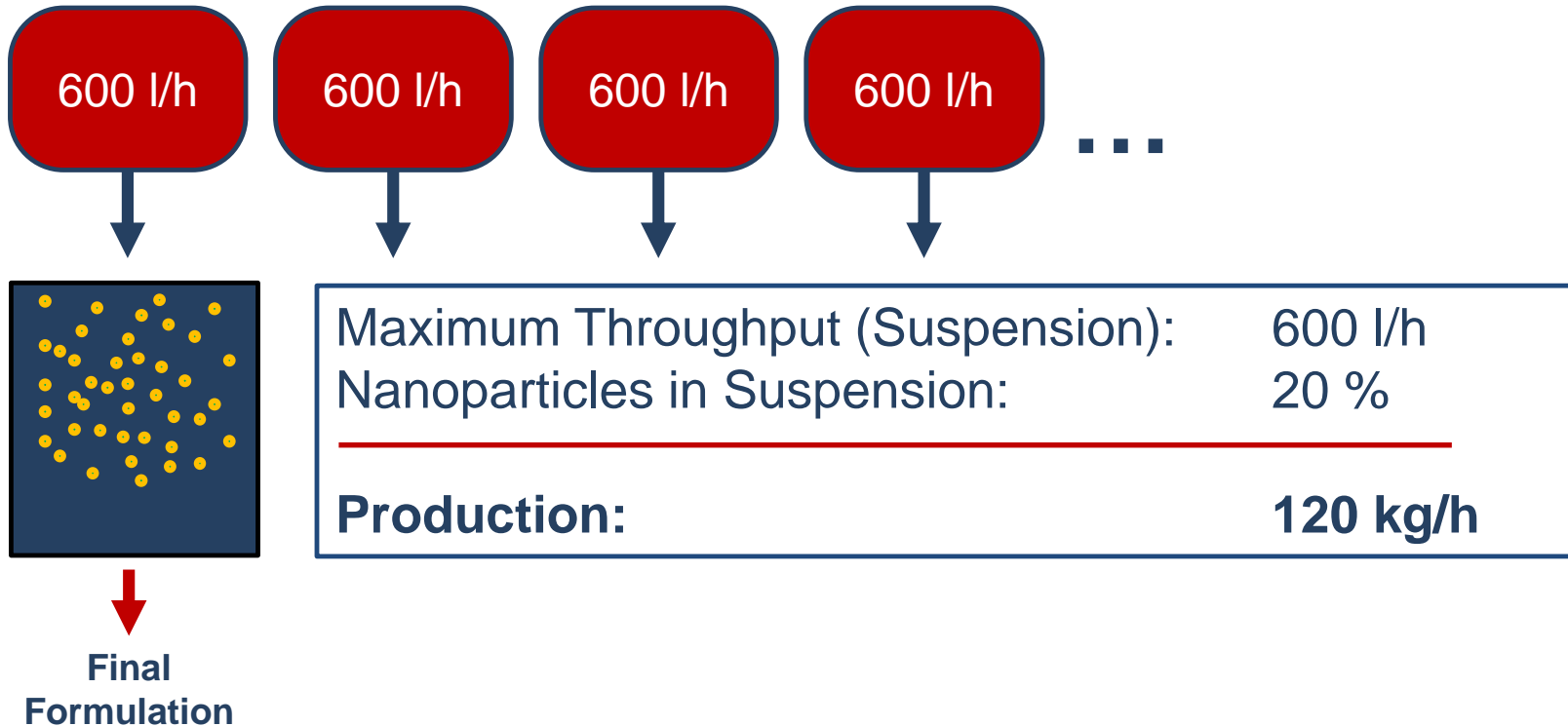
MJR Reactor for Small Scale Production

High Quality MJR Production Platform

- Manufacturing characteristics
 - *Robust Set-up*
 - *No contamination of product*
 - *Easy to clean*
 - *Use of pharmaceutical and food compliant materials*
- IPC (In Process Control) easy to realize
- QbD (Quality by Design) production possible
- Use of advantages of Microreactor-technology
 - *Use of different reaction types possible*
 - *Specific, efficient reaction environment*
 - *Minimized side reactions*
- Continuous production up to tons
 - *No clotting by MJR-Design*
- Closed system
- Inert or desired reaction environment by different gas type input
- Temperature, pressure and other parameters scalable in a wide range up to supercritical conditions
- CIP (Cleaning In Place) and/or SIP (Sterilization In Place)
- Integrated safety concept – low environmental impact
- Low process costs
- Easy to integrate in given process chains



High Production Capacity through Parallelization



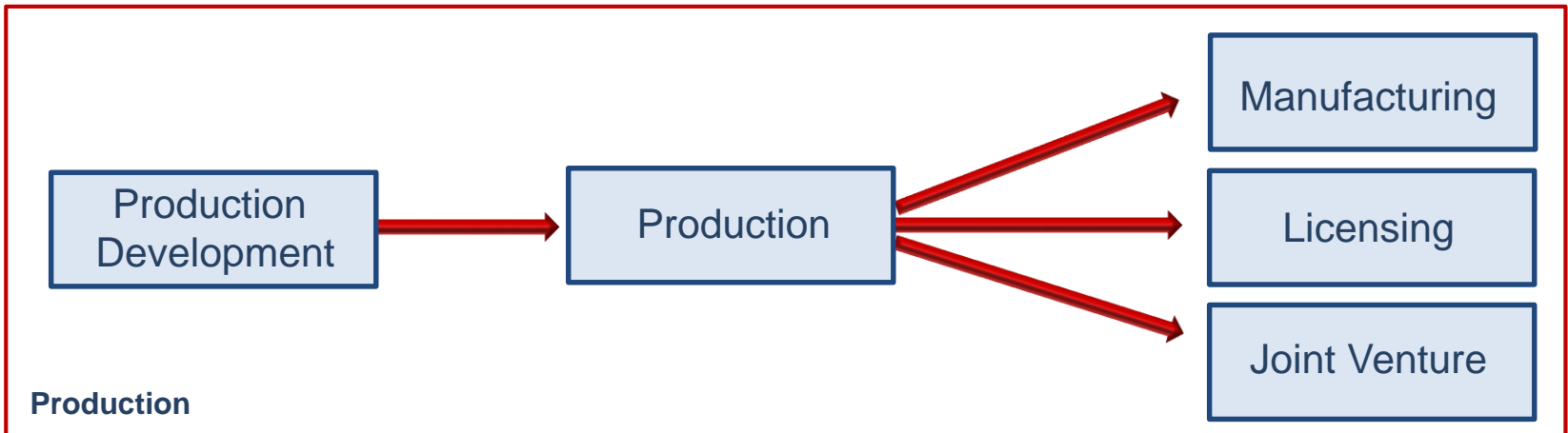
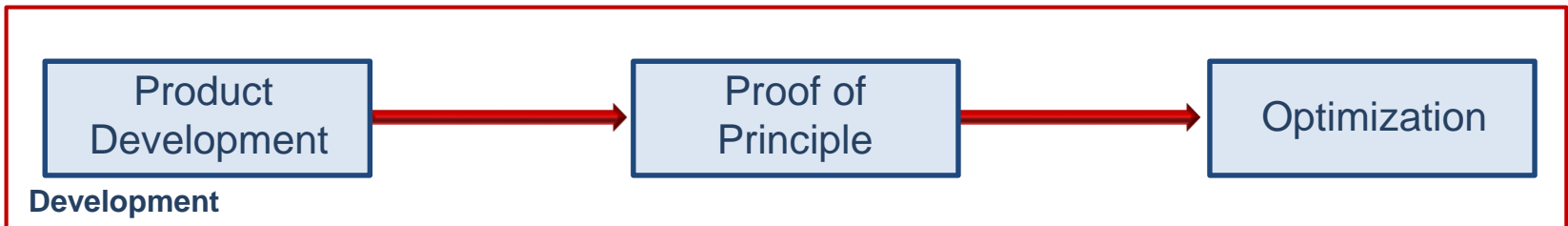
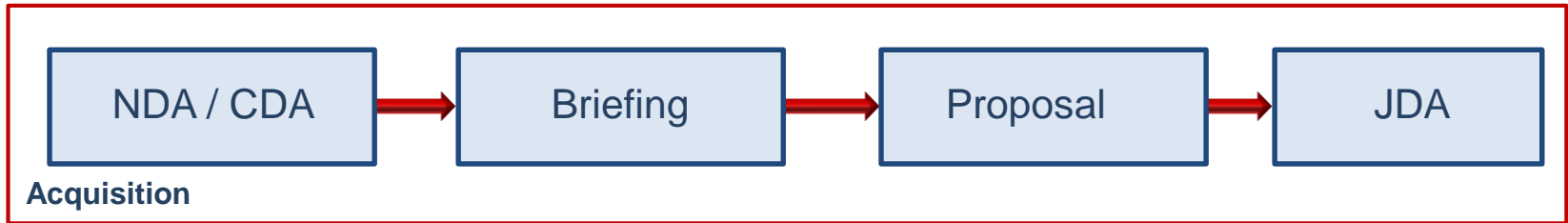
Very Cost Effective Production Process

MJR MicroJet Reactor – Unique Characteristics

Generally applicable	Complexity	Yield & Capacity	Continuous Process
<p>GENTLE</p> <ul style="list-style-type: none">▪ Applicable for heat & O₂ sensitive substances▪ No thermal stress & no contact with air for ingredient <p>CLEAN</p> <ul style="list-style-type: none">▪ No toxic solvents▪ No contamination of ingredient	<p>ROBUST</p> <ul style="list-style-type: none">▪ Only few & easy controllable process parameters <p>STRAIGHT FORWARD</p> <ul style="list-style-type: none">▪ Bottom-up▪ 1-step reaction▪ Flexible process that allows production of complex structures	<p>FAST</p> <ul style="list-style-type: none">▪ Capacity up to 600 l/h▪ Short processing time▪ Continuous process <p>EFFICIENT</p> <ul style="list-style-type: none">▪ 100% ingredient recovery in galenic process	<p>FLEXIBLE</p> <ul style="list-style-type: none">▪ Easy scale-up by parallelization▪ Identical machinery for small & large scale production▪ Identical process parameters for small & large scale production

Economic continuous production platform with low COGS

Our Business Approach



Our Business Sectors



Consumer Goods



Nutrition



Aerosols



Chemicals



Fire Retardants



Cosmetics



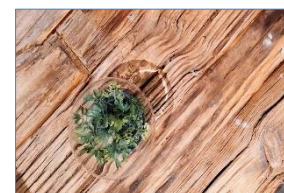
Oleoresins



Foils & Films



Lubricants



Wood Protection



Flavors & Fragrances



Animal Health



Polymers



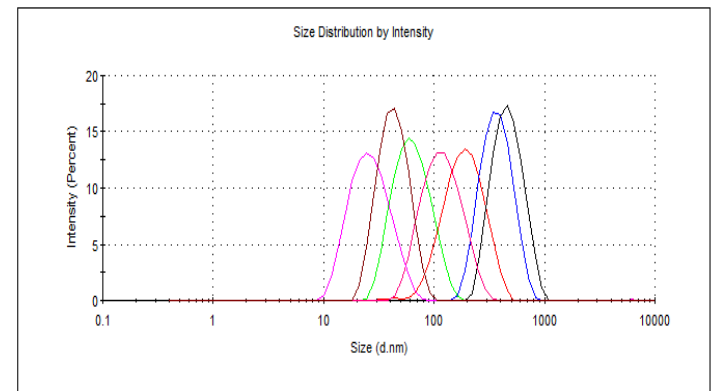
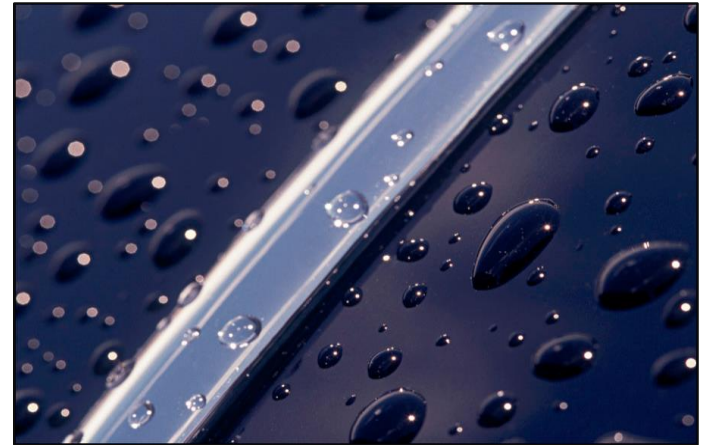
Cement



Car Paints

Nano-Barium Sulfate

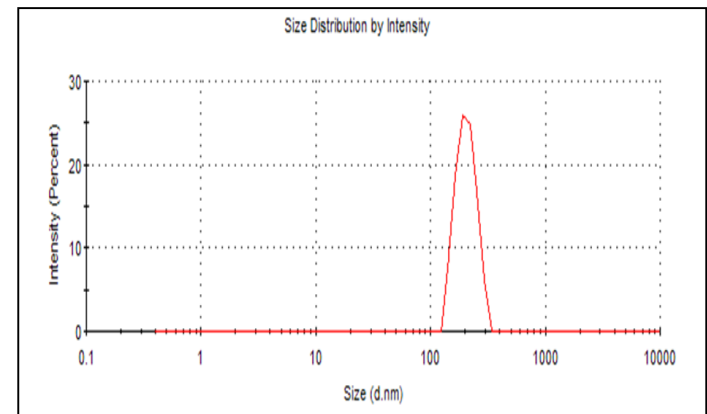
Production:	MicroJet Reactor
Synthesis:	$\text{BaCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{BaSO}_4$
Surface Modifier:	Polycarboxylate Ether Polymer
Stabilization:	Organo-modification to prevent nanoparticles from aggregation
Particle size:	Controlled average median between 20 - 450 nm
Homogeneity:	PDI < 0.2
Colloidal dispersion:	2 % - 20 % concentration in water
Application areas:	Paints for Automotive Industry Pigment and Filler for Paints Paper Brightener & Filler Photo Paper Coating Plastics Filler for Resistance & Opacity Synthetic Textiles Filler for Resistance Radio Contrast Imaging Agent Catalyst Support for Hydrogenating Coating of Copper Anode Plates



Particle size distribution of BaSO₄

Biocidal Copper Carbonate Nanoparticles

Production:	MicroJet Reactor
Synthesis:	Basic PEG-containing solution of copper hydroxide (pH 14) + CO ₂
Surface Modifier:	Acrylic Acid
Stabilization:	Organo-modification to prevent nanoparticles from aggregation
Particle size:	Controlled average median of 200 nm
Homogeneity:	PDI 0.01
pH:	7.4
Colloidal dispersion:	10% concentration in PEG-containing solution
Application areas:	Wood Conservation Anti-Fouling, Plastics & Fibers, Cleaning Electronics

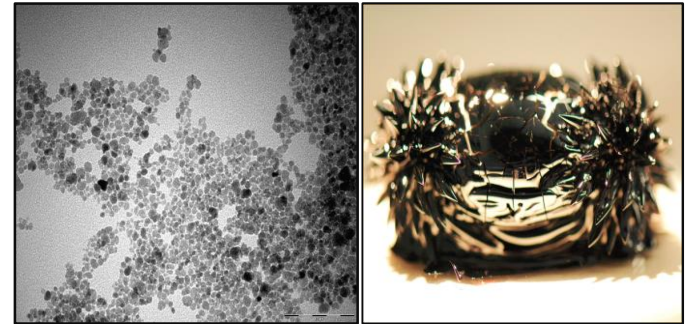


Particle size distribution chromatogram of copper carbonate nanoparticles

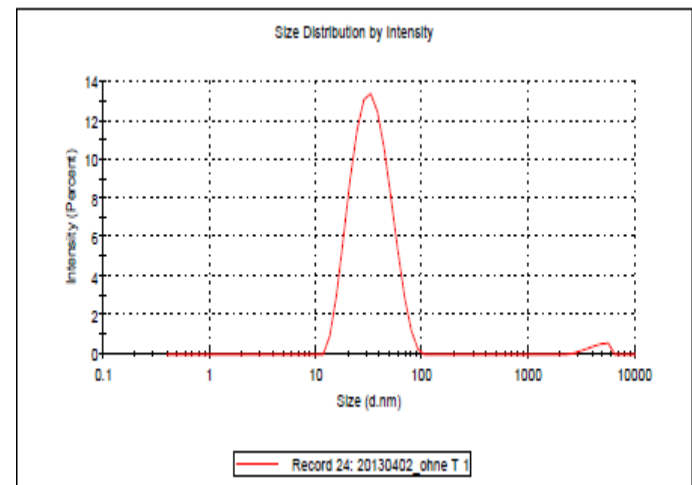
SPION Nanoparticles (Ferrofluide)

Production:	MicroJet Reactor
Synthesis:	$\text{FeCl}_2 + \text{FeCl}_3$ and NaOH
Surface Modifier:	Sodium Citrate
Particle size:	Controlled average median around 20 - 30 nm
Homogeneity:	PDI < 0.2
Colloidal dispersion:	2 % - 20 % concentration in water
Application areas:	Plastic Foils Additive Electronics Reversible Bonding Diagnostics Imaging

SPION = Super Paramagnetic Iron Oxide Nanoparticles



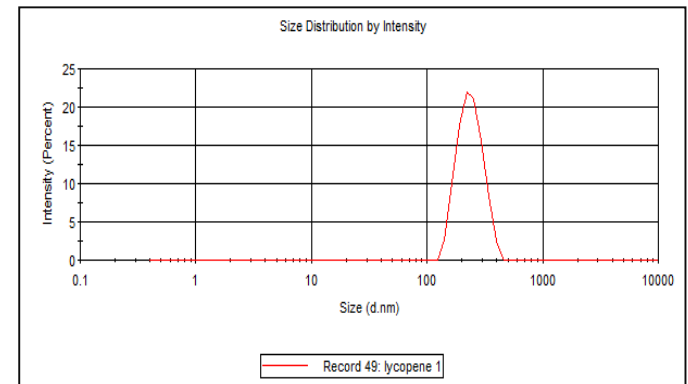
TEM / picture of SPION nanoparticles



**Particle size distribution
of SPION 30 nm with a PDI of 0.197**

Nano-sized Encapsulated Lycopene

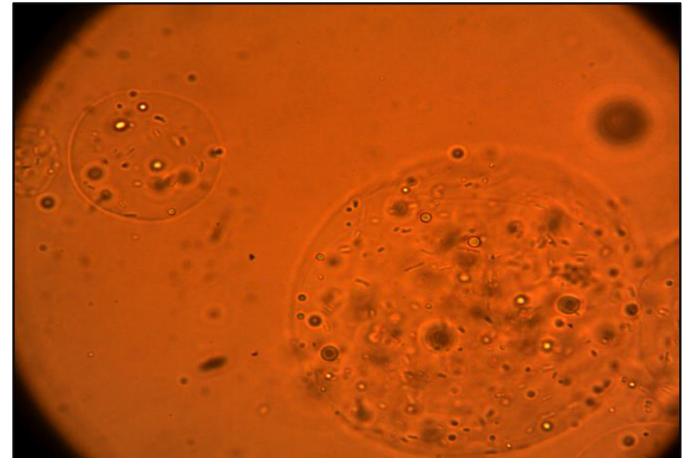
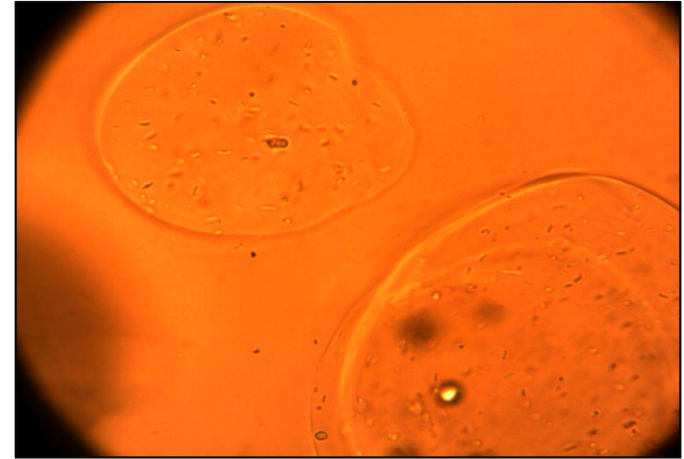
Production:	MicroJet Reactor
Preparation method:	Precipitation
Encapsulation polymer:	Shellac Aqua Gold SSB Polysorbat 60
Particle size:	Controlled average median of 225.7 nm
Homogeneity:	PDI 0.162
Colloidal dispersion:	0.5 % in water
Advantages:	Water dispersible Oxidation protected
Application areas:	Food & Beverages



Particle size distribution of encapsulated tomato extract

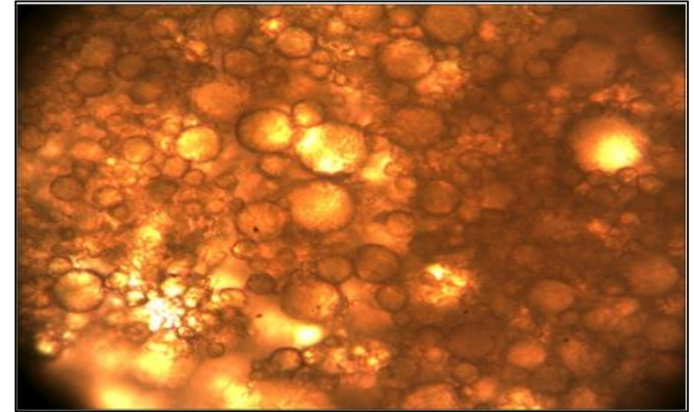
Microencapsulated Lactic Acid Bacteria

Production:	MicroJet Reactor
Preparation method:	Gelation
Encapsulation polymer:	Alginate Alginate + Gelatine
Stabilization:	Whey Protein Gummi Arabicum Xanthan Gum Pectin
Advantages:	Protection against adverse environment to ensure viability survival of passage through the upper digestive tract
Application areas:	Cosmetics Food Beverages Nutrition Supplements Infant Food Dairy Products



Microencapsulated Perfume

Production:	MicroJet Reactor
Preparation method:	Double emulsion
Encapsulation polymer:	Compritol Gummi Arabicum Gelatin
Particle size:	Controlled capsule size of 30 μm
Homogeneity:	Narrow particle size distribution
Advantages:	Retard release of perfume
Release mechanism:	Mechanical stress
Application areas:	Cosmetics Consumer Products



**Encapsulated perfume
before mechanical stress**



Lubricant Emulsions

Production:	MicroJet Reactor
Synthesis:	Reactive thixotropic Components in Oils
Emulsifier:	Diverse
Stabilization:	Sterical
Droplet size:	100-300 nm
Homogeneity:	PDI < 0.2
Type of Emulsion:	w/o
Application areas:	Lubricants



Enteral Nutrition Emulsions

Production:	MicroJet Reactor
Synthesis:	Essential Oils in Water
Emulsifier:	Diverse food grade biopolymers
Stabilization:	Mostly electrosterical
Droplet size:	100-200 nm
Homogeneity:	PDI < 0.2
Type of Emulsion:	o/w
Application areas:	Enteral Nutrition



Dressings & Mayonnaise

Production:	MicroJet Reactor
Synthesis:	Food grade Oils in Water
Emulsifier:	Diverse food grade biopolymers
Stabilization:	Mostly electrosterical
Droplet size:	100-200 nm
Homogeneity:	PDI < 0.2
Type of Emulsion:	o/w
Application areas:	Food



Oxidation Protected Vitamin C Emulsions

Production:	MicroJet Reactor
Synthesis:	Vitamin C Solution in Oil
Emulsifier:	Diverse cosmetic grade biopolymers
Stabilization:	Mostly electrosterical
Droplet size:	100-200 nm
Homogeneity:	PDI < 0.2
Type of Emulsion:	w/o or w/o/w
Application areas:	Skin Care



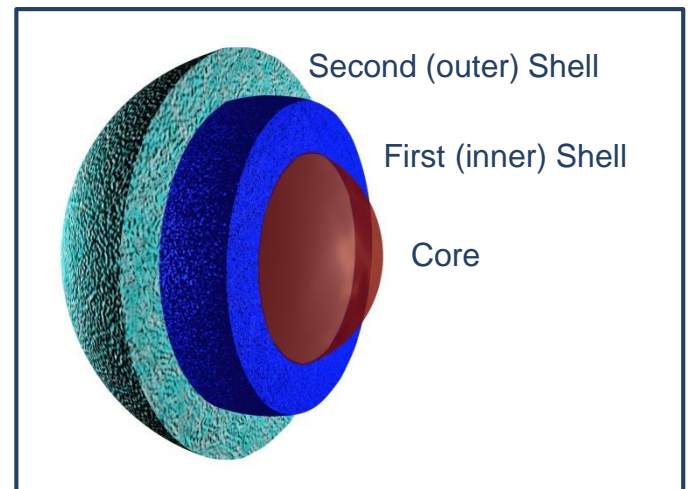
Joint Venture: KD Omega Health GmbH



- Products: Microencapsulated Omega-3
Nanoencapsulated Omega-3
Microencapsulated Omega-3 Multivitamin
KD-Kaps™
- Partner: KD Pharma GmbH
- Strength of Partner: KD Pharma has the best technology worldwide for Omega-3 concentration (up to 99 % purity)
Company grows extremely fast
- Market Volume: Worldwide approx. 2.5 billion US\$ in 2014
- CAGR: Approx. 10 % p.a.
- Distribution: Existing KD Pharma customer network
- Production: MJR machine in existing KD Pharma GmbH facilities

Microencapsulated Omega-3

Production:	MicroJet Reactor
Ingredients:	EPA/DHA 558/274
Encapsulation:	Sodium-Caseinate Xanthan Gum
Stabilization:	Two layer capsule
Capsule size:	50-100 micron
Load Factor:	Liquid with 15 % Omega-3
Application areas:	Infant Formula Food Dairy Beverages Nutritional Supplements Pharmaceuticals Clinical Nutrition Pet Food



KD Omega Health's patented MJR technology creates KD-Kaps™ Omega-3 that is both protected from oxidation and mixable in water.

Microencapsulated Omega-3 Gel in a Dual-Bag



Bag 1:

- Omega-3
- Lemon extract
- Stevia
- Xanthan

Bag 2:

- Orange Concentrate
- Xanthan



Innovation:

- Omega-3 is taste masked
- No oily taste
- Omega-3 is oxidation protected
- No fishy smell
- No reflux or burp effect
- Omega-3 release in small intestine
- Higher Omega-3 bioavailability
- Mixable in dairy products
- Mixable in drinks
- UV protected packaging
- Oxidation protected packaging
- Convenient usage with only 10 ml dosage per day
- First Omega-3 gel spray on the market

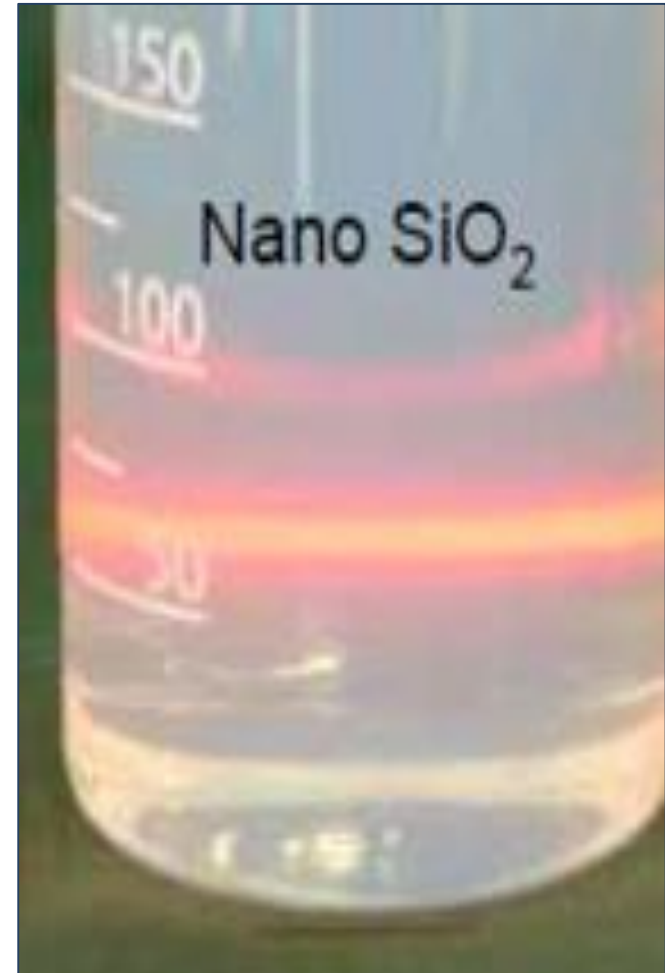
Joint Venture: nanoCementa GmbH



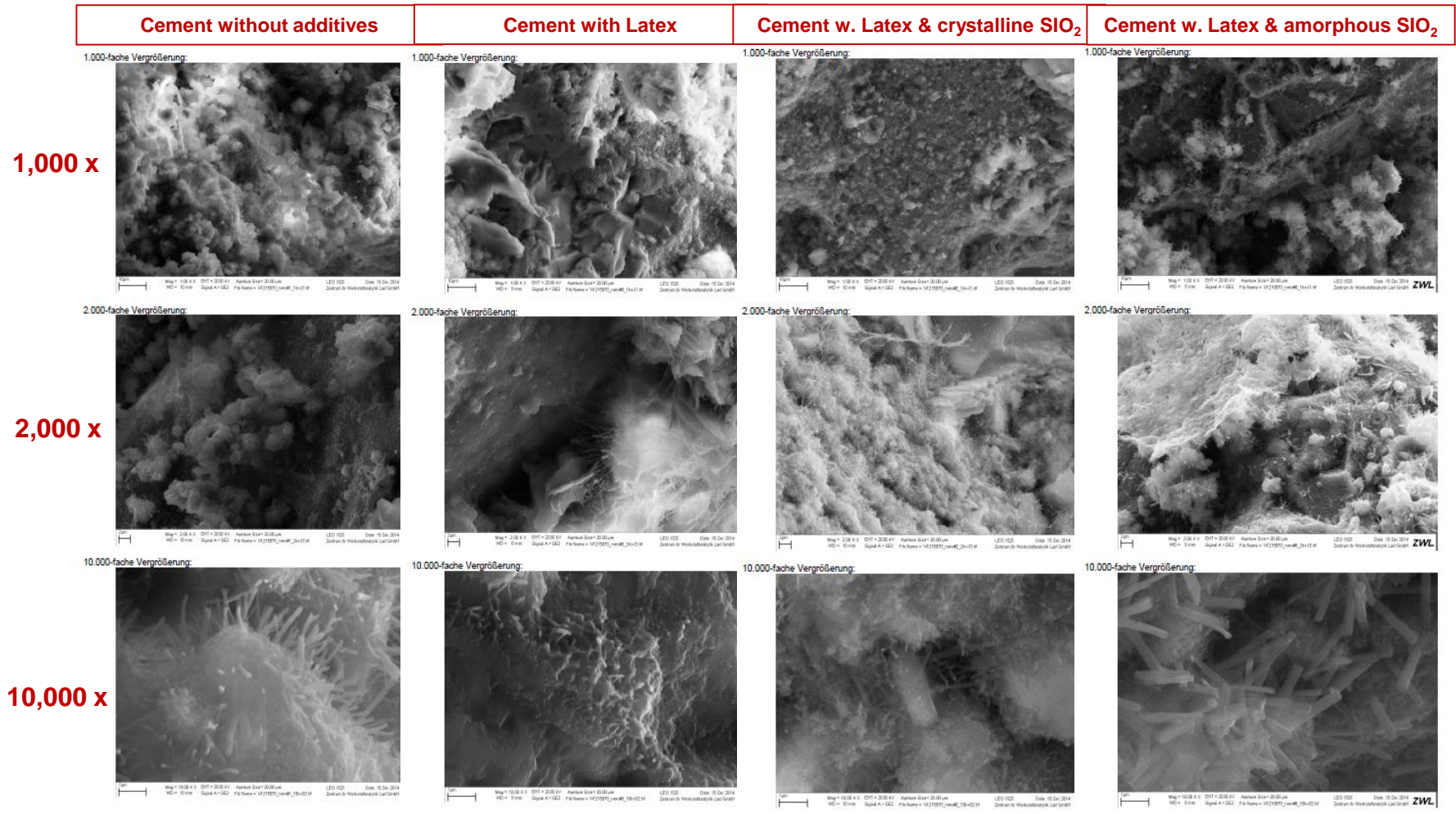
- Products:
 - NC Road (for road construction)
 - NC Drain (for dewatering systems)
 - NC Safe (for waterproof dike building)
 - NC Superplasticizer (for better rheology)
- Partner: Nano GmbH
- Strength of Partner:
 - Fully developed and proven products
 - Hundreds of km track record with NC Road
- Distribution:
 - Exclusive construction partners
 - Joint Ventures with partners in different regions/ countries
- Production:
 - Key chemical in-house
 - Local road construction partner for the final NC Road formulation

Silica Nanoparticle Dispersions

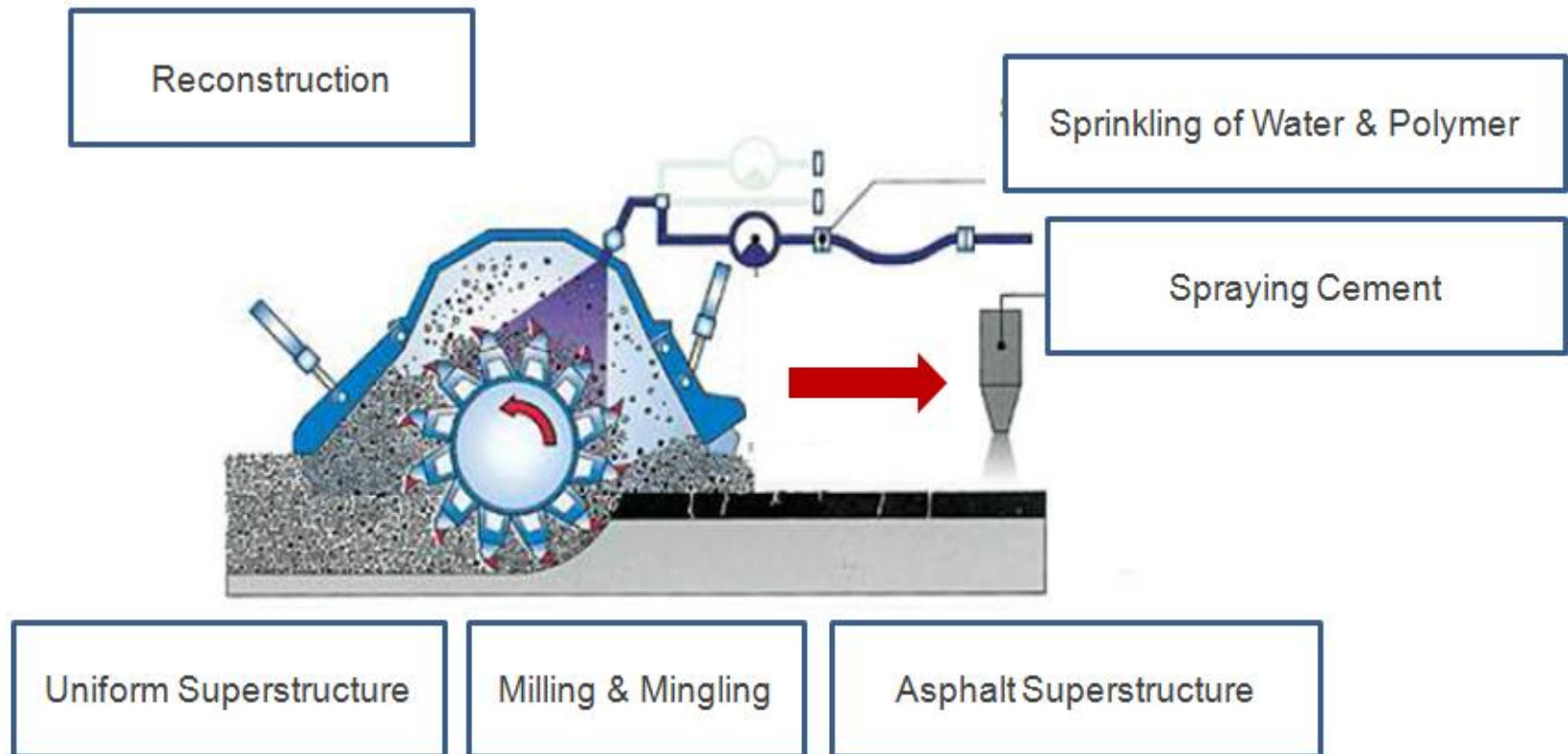
Production:	MicroJet Reactor
Synthesis:	Alkaline precipitation of acidic activated sodium silicate
Surface Modifier:	Sodium Citrate
Stabilization:	Electrosterical
Particle size:	d_{90} 19 nm
Homogeneity:	PDI < 0.2
pH:	8
Colloidal dispersion:	10 % concentration in aqueous solution
Application areas:	Construction Architecture Plastics & Fibers, Nano-composites Electronics Tires Food & Beverage



Much Better Matrix Binding with nano SiO₂



Road Construction Process



Our USP for Industrial Partners

Broad Application	Smart Design	Economic Production	Top Quality
Release Options	Size Options	Rapid Scale-Up	No Toxics
<ul style="list-style-type: none"> Release at certain temperatures 	<ul style="list-style-type: none"> Particles between 10 nm and 10 µm 	<ul style="list-style-type: none"> From 1 l/h in lab scale to 600 l/h for ton scale production per unit 	<ul style="list-style-type: none"> No toxic solvent required
<ul style="list-style-type: none"> Release at certain pH 	Capsule Options	<ul style="list-style-type: none"> Parallelization for further increase 	<ul style="list-style-type: none"> Tenside free
<ul style="list-style-type: none"> Release on shear 	<ul style="list-style-type: none"> Nano emulsions 	<ul style="list-style-type: none"> Low cost production 	Reproducible
Stability Options	<ul style="list-style-type: none"> Liposomes 	Efficient	<ul style="list-style-type: none"> Very homogenous particle sizes
<ul style="list-style-type: none"> Protection against oxygen 	<ul style="list-style-type: none"> Micelles 	<ul style="list-style-type: none"> 95% - 99% load 	<ul style="list-style-type: none"> Polydispersity index PDI < 0,2
<ul style="list-style-type: none"> Stable at defined temperatures 	<ul style="list-style-type: none"> Polymer capsules with lecithin, poly-saccharides, cellulose and others 	<ul style="list-style-type: none"> 95% - 99% polymer usage 	<ul style="list-style-type: none"> Process parameters can be easily controlled and monitored
<ul style="list-style-type: none"> Stable at defined chemical conditions 	Fast Development	Continuous Flow	Certified
Gentle	<ul style="list-style-type: none"> Easily controllable production parameters 	<ul style="list-style-type: none"> Continuous flow production process 	<ul style="list-style-type: none"> Process certified for pharmaceutical production
<ul style="list-style-type: none"> No thermal stress 	<ul style="list-style-type: none"> Lab automation ready 	<ul style="list-style-type: none"> Little energy consumption 	
<ul style="list-style-type: none"> No contact with oxygen 		<ul style="list-style-type: none"> „Green process“ 	

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