

HORIBA Instruments, Inc.

Scientific Division

Ian Treviranus

**At First Blush:
The Importance of Particle
Characterization for Cosmetics**

April 22, 2015

What we'll talk about

- **Featured technologies**
- **Importance to industry**
- **Application examples**
- **Q&A**

Your interests

- ✓ • **Available technologies**
- ✓ • **How to accurately, reproducibly measure nanoparticles**
- **Best practices**
- ✓ • **Zeta potential**
- ✓ • **Pastes**
- ✓ • **Data interpretation**
(webinars TR008, TR010, TR015)



Featured technologies

- **LA-960 / LA-300**
Laser Diffraction
- **SZ-100**
Dynamic Light Scattering & Zeta Potential
- **CAMSIZER & CAMSIZER XT**
Dynamic Image Analysis
- **PSA300**
Static Image Analysis
- **SA-9600**
Flowing Gas BET Surface Area

LA-960: Laser Diffraction

- **Particle size performance leader**
- **Tenth generation design**
- **Suspension, emulsion, powder, paste, gel**
- **Lowest total cost of ownership**
- **Ultra durable**
- **10 nanometer – 5 mm**



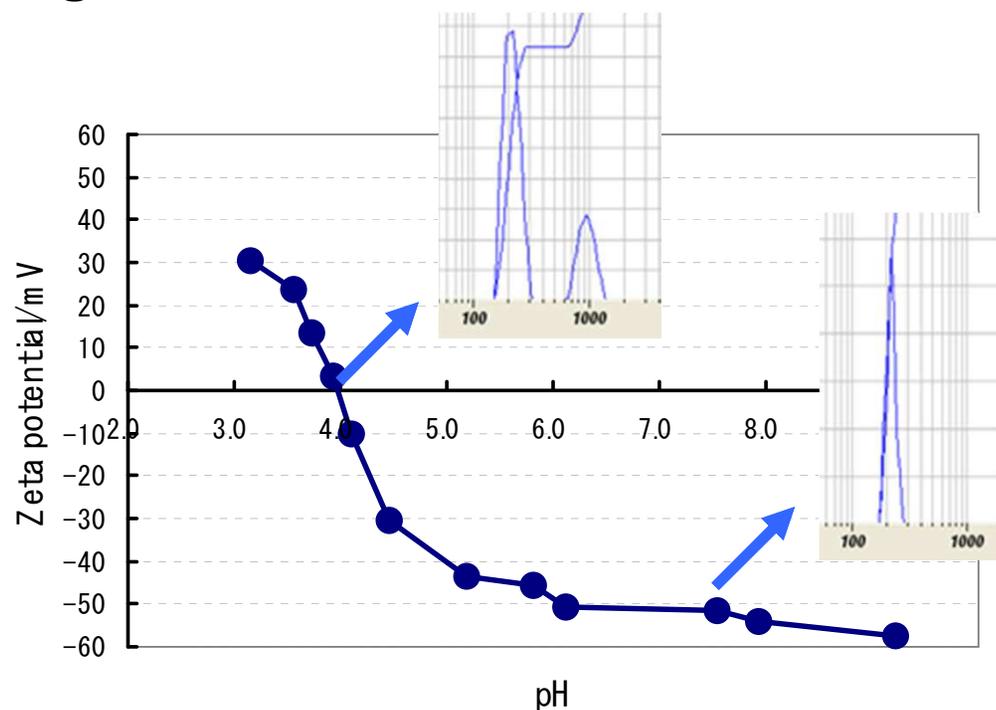
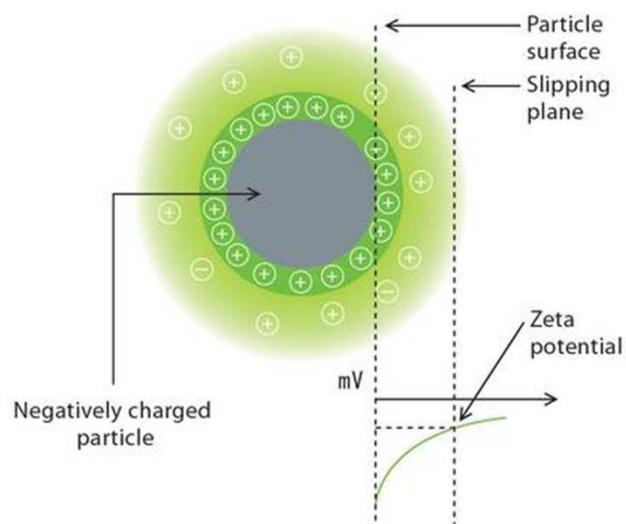
SZ-100: Nanoparticle Analyzer

- **Nanoparticle size & zeta potential**
- **Low total cost of ownership**
 - Innovative, patented graphite electrodes
 - Requires only microliters
- **Suspensions & emulsions**
- **0.3 nanometers – 8 microns**



Zeta Potential: Dispersion Stability, IEP

Measures particle surface charge
High zeta potential = stable
Low zeta = unstable, aggregate



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Why Do We Care?

- **Particle size affects...**

- **Texture/skin feel**
- **Color density/tint**
- **Smoothness**
- **Powder flow/compaction**



- **Zeta potential tells us...**

- **Product stability**

Particles in Cosmetics

- **Any product containing a powder**
- **Pigments, talc, mica**
- **Emulsions (creams, lotions)**
- **Liposomes; simple, complex**

- **Types of cosmetics containing particles (emulsion droplets)**

Lips	Lip gloss • Lip liner • Lip plumper • Lipstick
Face	Concealer • Foundation • Face powder • Rouge • Bindi • Thanaka • Tilaka • Cleanser-Toner-Moisturizer
Eyes	Eye liner • Eye shadow • Kohl • Mascara
Other	Shampoo-Conditioner-Styling cream • Nail polish • Anti-aging cream • Body powder • Cold cream • Sindoor

Original Foundation: Pan-Cake

MERLE OBERON
in Benedict Boggs' "DARK WATERS"
A United Artists Picture

★ It creates a lovely new complexion

★ It helps conceal tiny complexion faults

★ It stays on for hours without re-powdering

YOUTHFUL loveliness... this is the glamorous secret to your natural beauty that you can expect with your very first make-up with "Pan-Cake". You'll really be thrilled when your mirror reveals a lovely new complexion... soft, smooth, clear and young-looking. For new beauty today, tonight... try this glamorous secret from Hollywood which has become the make-up fashion with millions of girls and women. Remember, there is only one "Pan-Cake"... the original, created by *Max Factor Hollywood* for Technicolor pictures, the Hollywood stars, and you.

Pan-Cake Make-Up
AN EXCLUSIVE FORMULA PROTECTED BY U.S. PATENT NOS. 2024877-2101834

ORIGINATED BY **MAX FACTOR HOLLYWOOD**

- **Foundation and powder in one**
- **Base was talc (particle), not oil or wax**
- **Applied with wet sponge**
- **Patent in 1937**
- **By 1940 1 in 3 North American women owned & wore Pan-Cake**

Create our Own Product

- **Base**
 - Talc, rice powder



- **Pigment**
 - Iron oxide



- **Filler**
 - Clay



- **Glitter**
 - Mica



- **SPF**
 - TiO₂

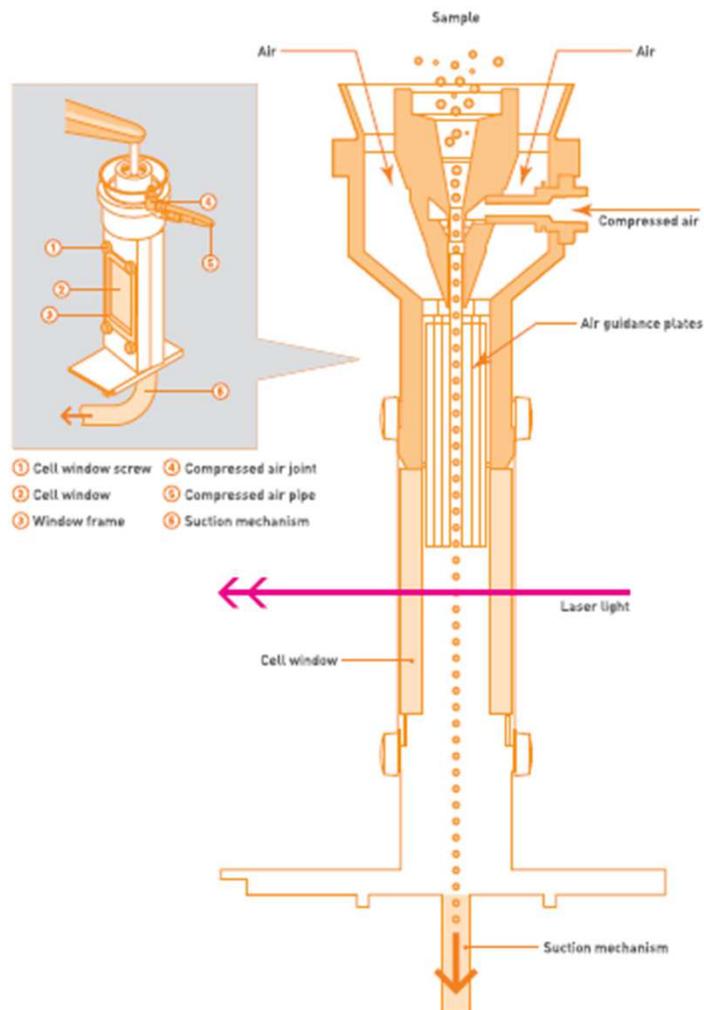


They're all particles!

Can measure size of all using one system: LA-960



Measure Powders as Powders



- **Simplify dispersing**
- **Quick, easy, clean**
- **Measure in natural state for more actionable results**
- **Lower costs**

Webinar TE016: Optimizing Dry Powder Measurements

Reduce Solvent Use



MiniFlow

Fully automated pumping system
40 mL total volume
Built-in ultrasonic probe



Fraction Cell

5, 10, 15 mL volume
Needs only micrograms

Application Note 176: Minimizing Sample Quantity

LA-960 Method Expert

- **Unique guided method development**
- **Easily choose measurement and calculation conditions**
- **Choose the best refractive index**
- **Create “one button” SOPs**



What we'll talk about

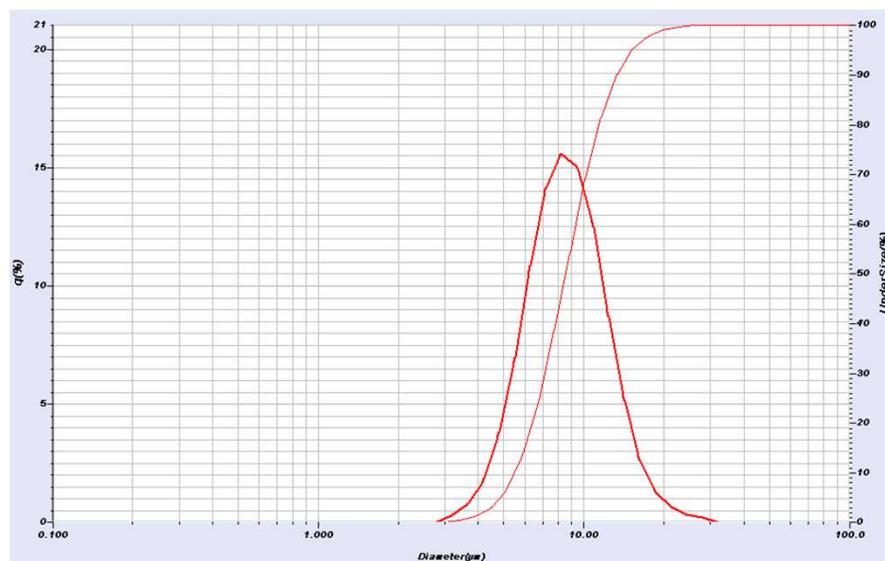
- **Featured technologies**
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- **Application examples**
- **Q&A**

Base: Rice Powder



Air	: 0.3 MPa
Transmittance(R)	: 97.6(%)
Sample Data Acquisition Times (LD)	: 5000
Refractive Index (R)	: 1.53-0.0i[1.53-0.0i(1.530 - 0.000i)]
Iteration Number	: 15
Feeder	: Auto
Data Name	: Rice Powder Max Dry - 01
Model Type	: LA950DRY

D(v,0.1)	: 5.50291(μm)
D(v,0.5)	: 8.54916(μm)
D(v,0.9)	: 13.30517(μm)

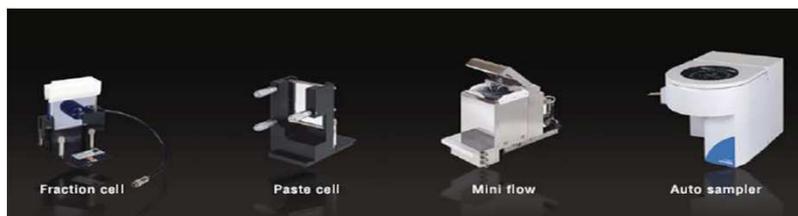


Iron Oxide – 170 Shade

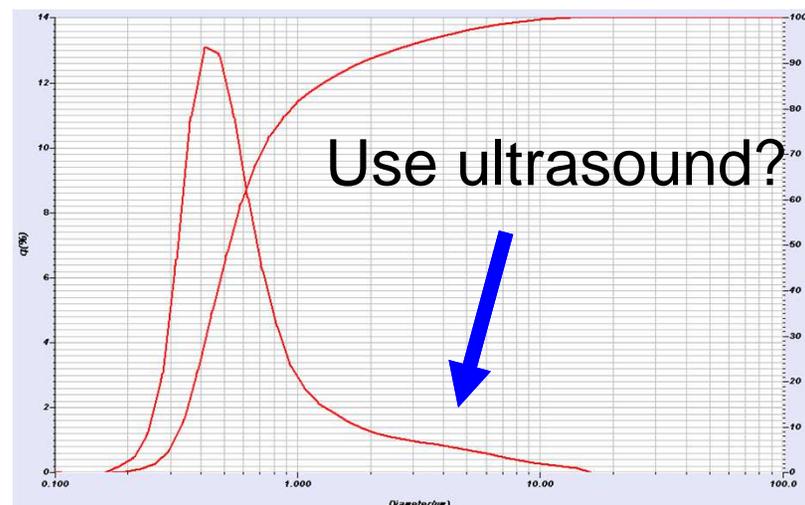


Transmittance(R)	: 78.0(%)
Sample Data Acquisition Times (LD)	: 5000
Refractive Index (R)	: 2.90-1.0i[2.90-1.0i(2.900 - 1.000i)]
Iteration Number	: 15
Data Name	: Red Iron Oxide 170 Max Wet - 01
Model Type	: LA950WET

D(v,0.1)	: 0.33179(μm)
D(v,0.5)	: 0.52325(μm)
D(v,0.9)	: 1.84123(μm)



LA-960 wet accessories
Disperse powder into a liquid
Can measure down to 30 nm



Gold Glitter Powder



Measure wet + dry, choose preferred
Verify correct pressure for dry powder feeder

Wet

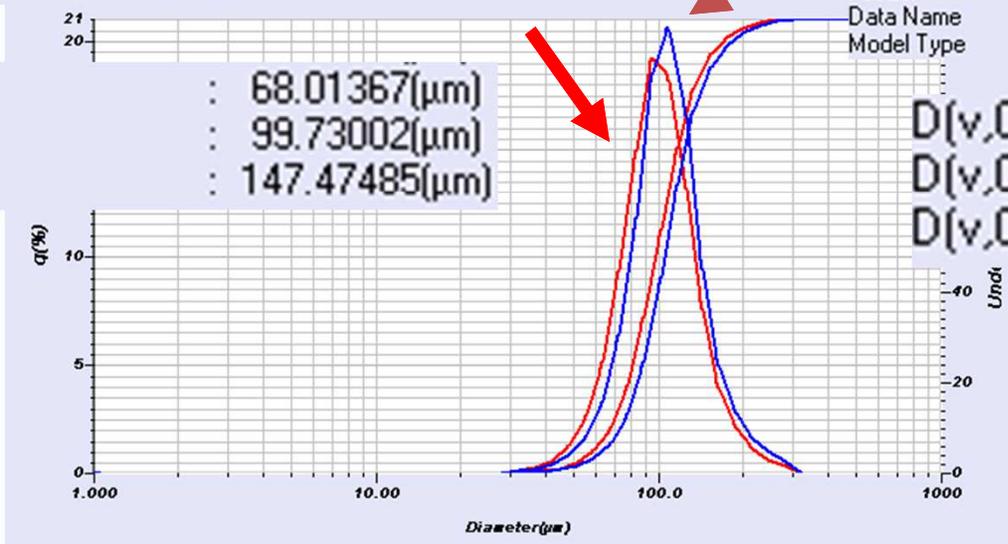
Dry

Transmittance(R) : 77.4(%)
Sample Data Acquisition Times (LD) : 5000
Iteration Number : 15
Refractive Index (R) : 1.59[1.59(1.590 - 0.100i),Water(1.333)]
Data Name : Gold Glitter Max Wet - 01
Model Type : LA950WET

Air : 0.3 MPa
Transmittance(R) : 98.3(%)
Sample Data Acquisition Times (LD) : 5000
Refractive Index (R) : 1.59[1.59(1.590 - 0.100i)]
Iteration Number : 15
Feeder : Auto
Data Name : Gold Glitter Max Dry - 01
Model Type : LA950DRY

D(v,0.1) : 68.01367(μm)
D(v,0.5) : 99.73002(μm)
D(v,0.9) : 147.47485(μm)

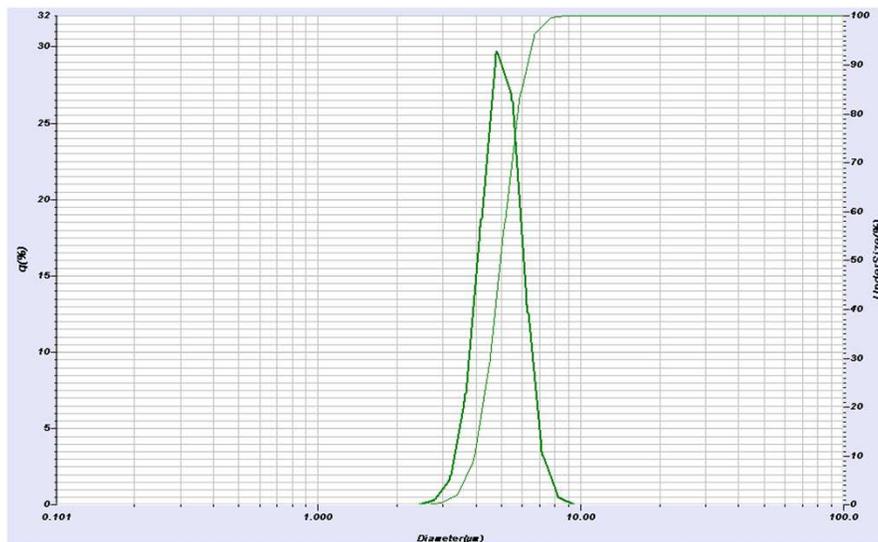
D(v,0.1) : 73.44803(μm)
D(v,0.5) : 106.93343(μm)
D(v,0.9) : 156.32506(μm)



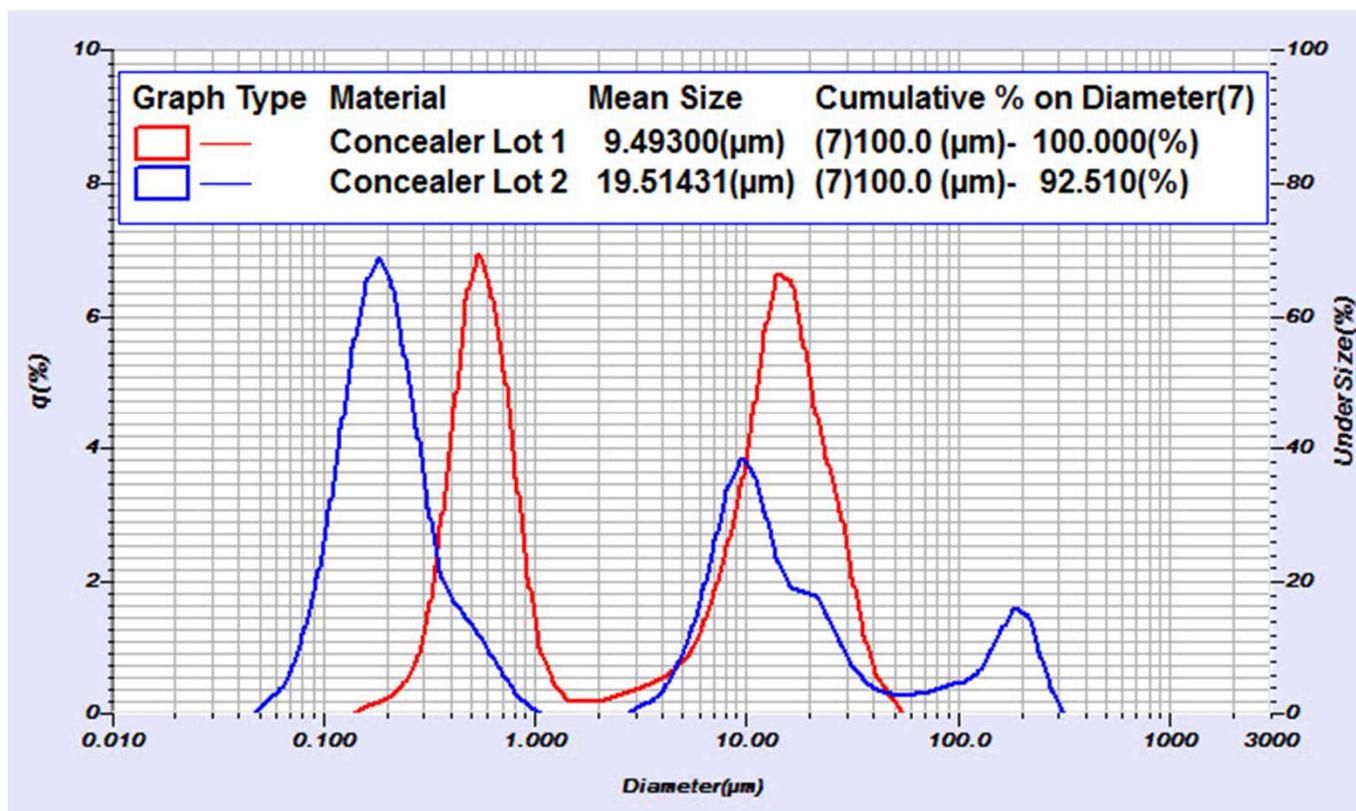
Mica

Air : 0.3 MPa
 Transmittance(R) : 98.2(%)
 Sample Data Acquisition Times (LD) : 5000
 Refractive Index (R) : 1.59-0.1i(1.590 - 0.100i)
 Iteration Number : 150
 Feeder : Auto
 Data Name : Mica Max Dry - 01
 Model Type : LA950DRY

D(v,0.1) : 3.94080(μm)
 D(v,0.5) : 4.96686(μm)
 D(v,0.9) : 6.28450(μm)



Quality Control / Troubleshoot



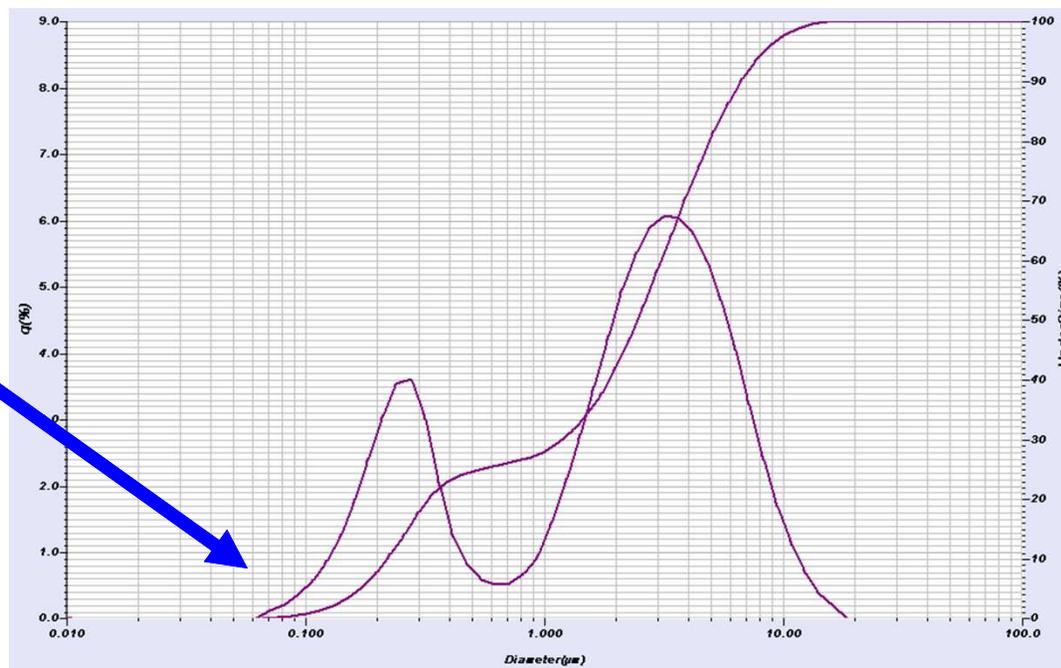
Kaolin clay



Transmittance(R)	: 85.6(%)
Sample Data Acquisition Times (LD)	: 5000
Refractive Index (R)	: 1.56-0.1i[1.56-0.1i(1.560 - 0.100i)]
Iteration Number	: 15
Data Name	: Kaolin Max Wet - 01
Model Type	: LA950WET

D(v,0.1)	: 0.22078(μm)
D(v,0.5)	: 2.46094(μm)
D(v,0.9)	: 6.65292(μm)

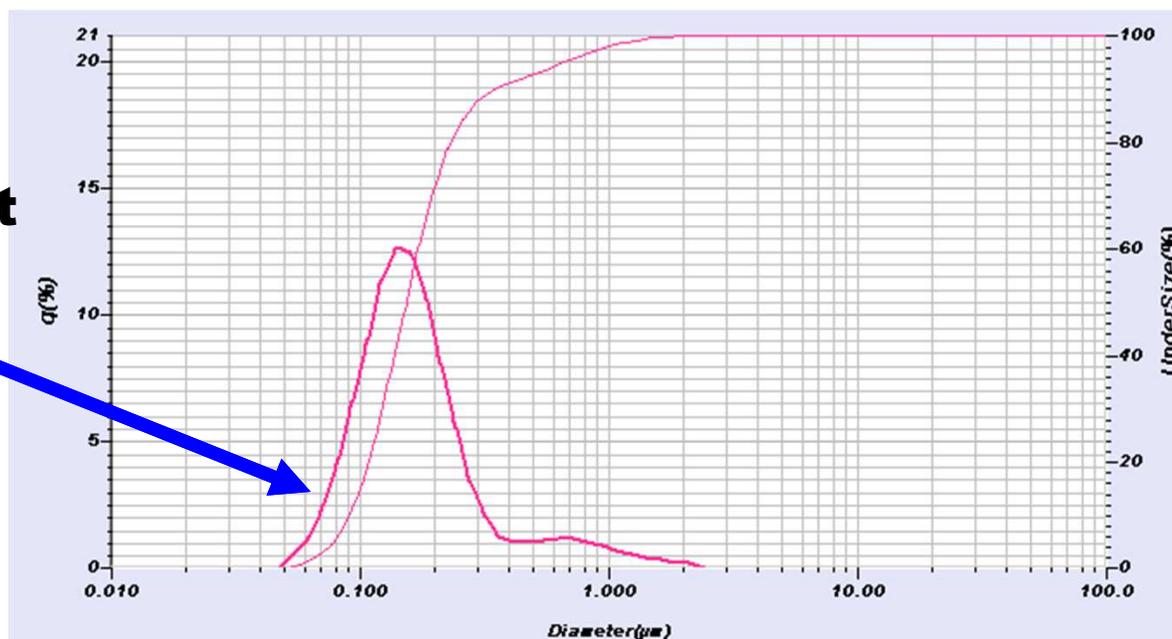
Note: small % below 100 nm, making this a “nanoparticle. Safety concerns?



Sunscreen with TiO2

Mean Size	: 0.21941(μm)
Median Size	: 0.15503(μm)
R Parameter	: 0.2560
D(v,0.1)	: 0.09093(μm)
Q(v,0.5)	: 0.15503(μm)
Ø(v,0.9)	: 0.36061(μm)
Cumulative % on Diameter	: (1)0.100 (μm)- 14.473(%)

Powder dispersed in water using surfactant and ultrasound.
Note: 14.5% < 100nm
Safety concerns?

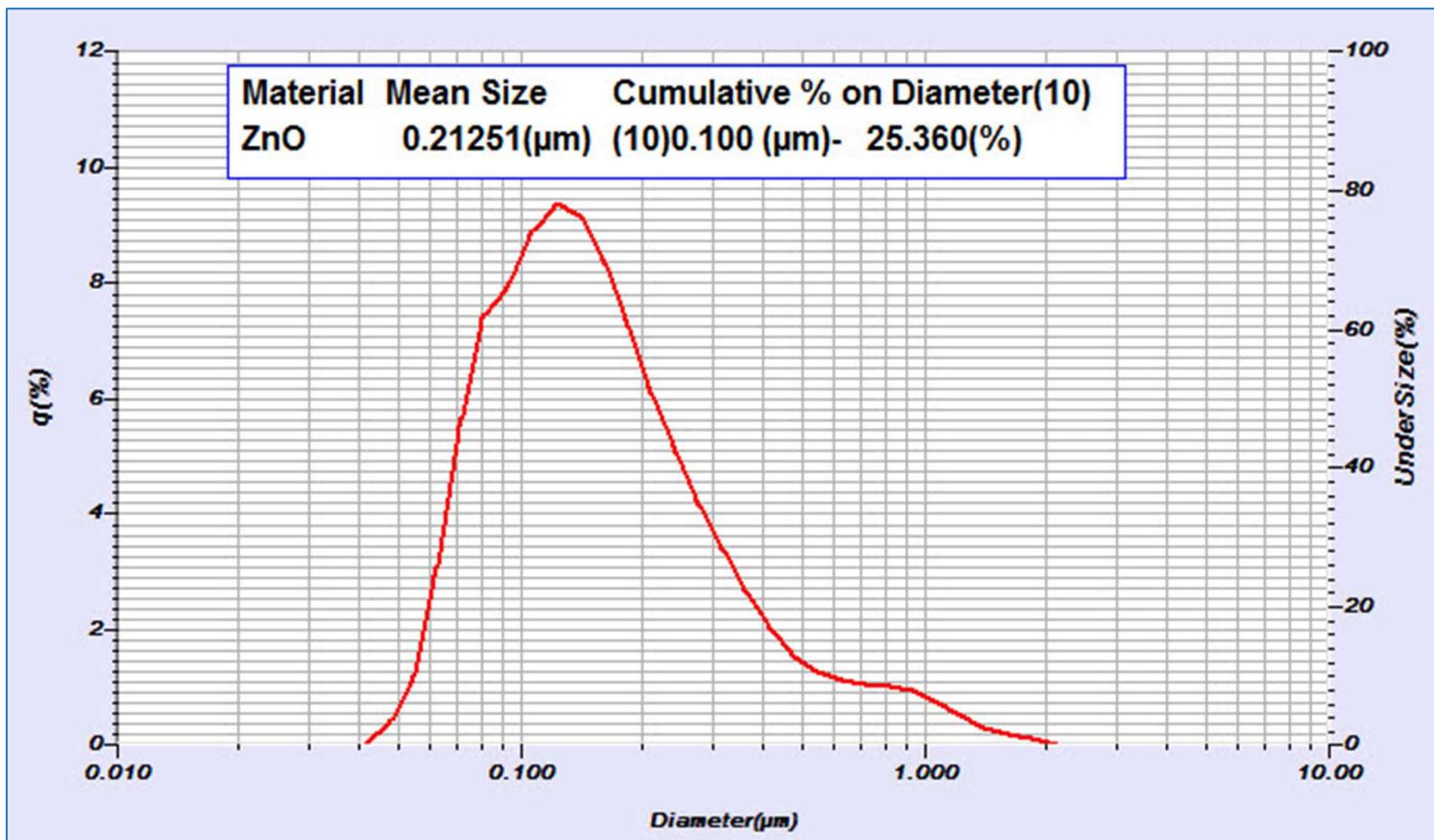


Measure without dilution

- **Concern that dilution in anything but perfect background will change PSD**
- **Possible solution with Paste Cell accessory**
- **Small amount of paste/gel/cream between two glass plates**

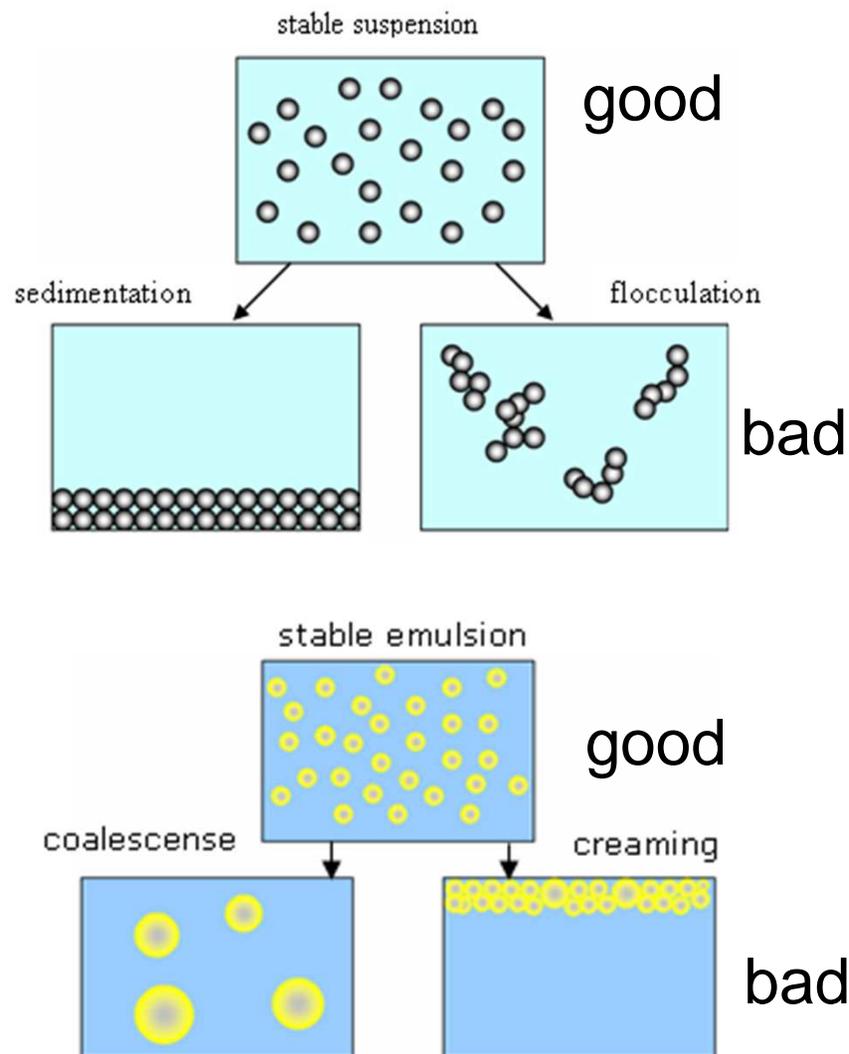


ZnO used in sunscreen



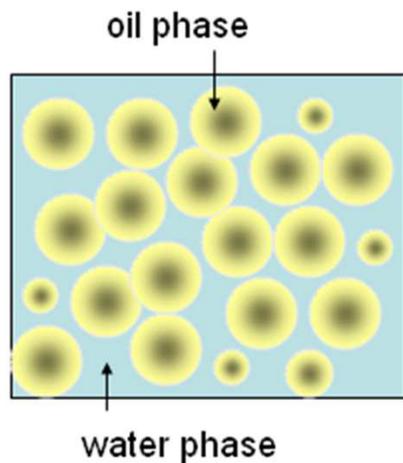
Stability

- Want stable dispersion
- Either suspensions or emulsions
- Suspensions sediment & flocculate
- Emulsions phase separate, creaming or coalescence

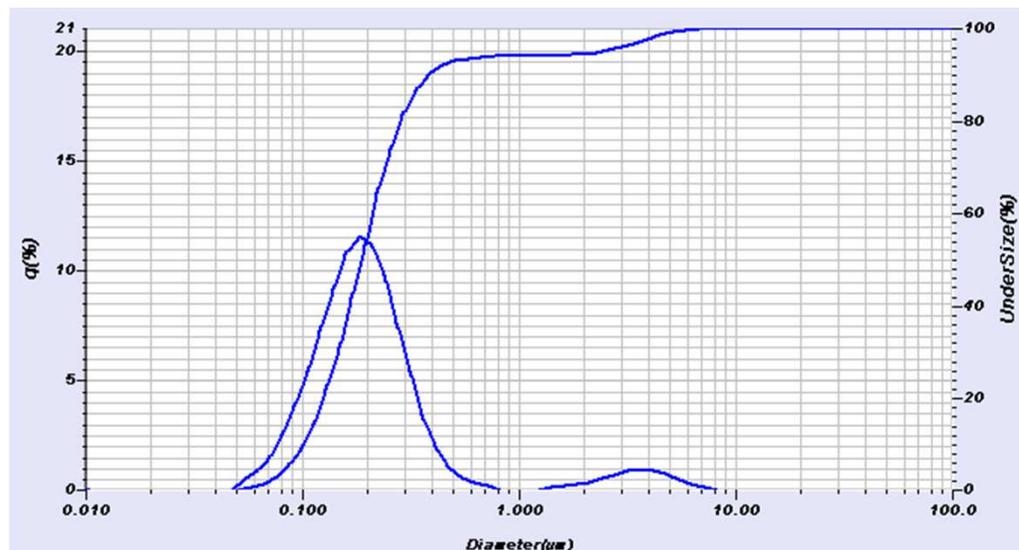


Skin Cream

Emulsion w/SPF 15

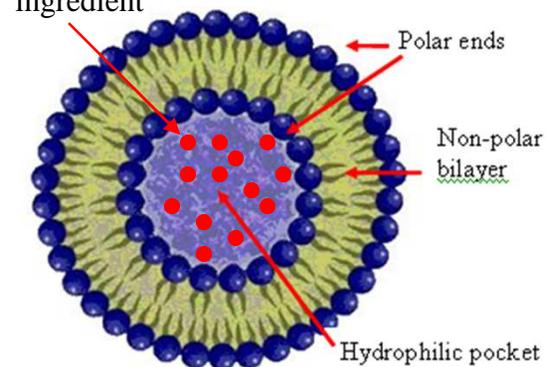


Mean Size	: 0.41213(μm)
Median Size	: 0.18935(μm)
Chi Square	: 5.313640
R Parameter	: 1.6789E-1
D(v,0.1)	: 0.10214(μm)
D(v,0.5)	: 0.18935(μm)
D(v,0.9)	: 0.38762(μm)
Cumulative % on Diameter	: (1)0.100 (μm)- 9.155(%)

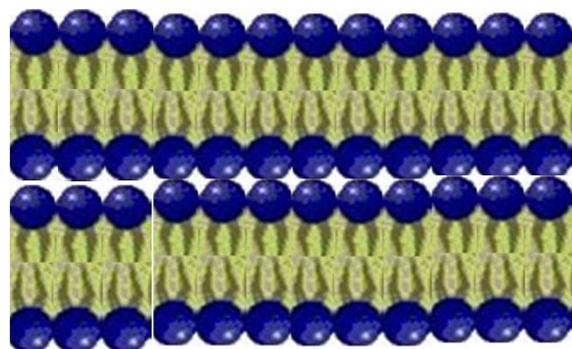


Liposome Delivery

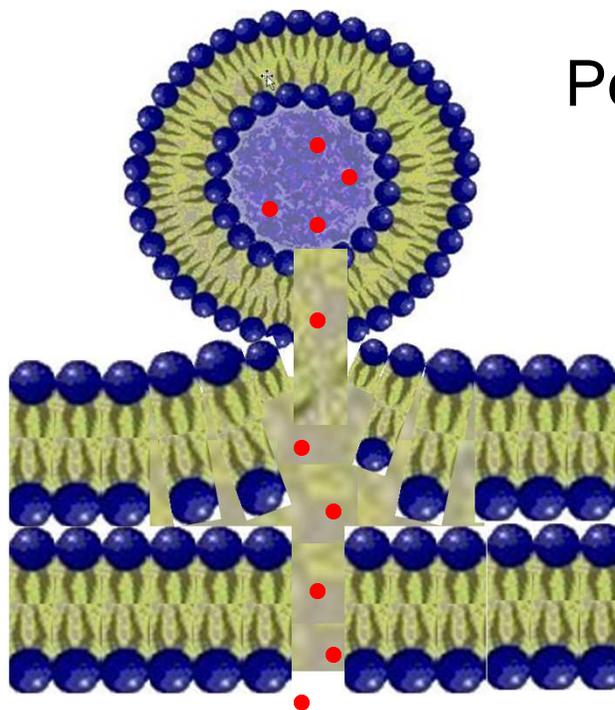
Active ingredient



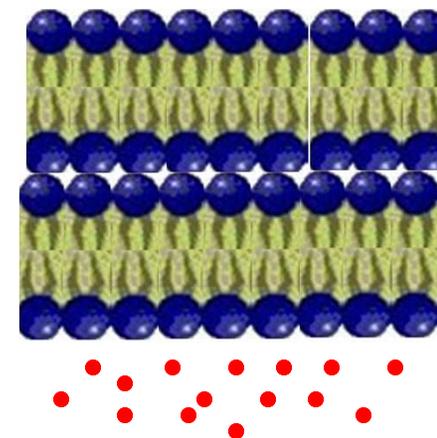
Penetrates into skin



Liposome approaches skin barrier layer

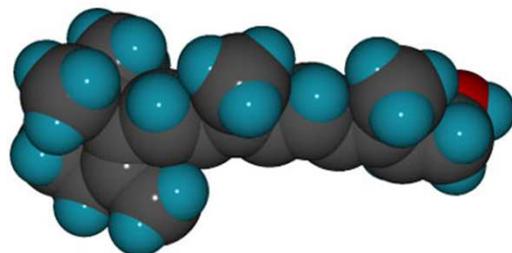
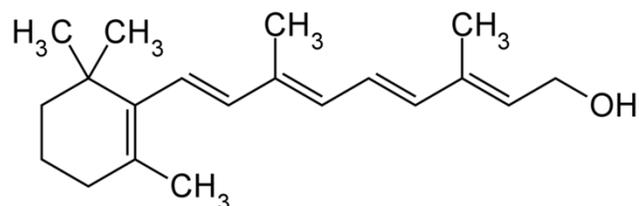


Liposome fuses with skin barrier layer



Liposome dissolves & releases actives (retinol?)

Retinol Formulation - Delivery



(57)

ABSTRACT

The present invention concerns stabilized cosmetic material containing triple-encapsulated retinol. Unstable, fat-soluble retinol is stabilized firstly by addition into vesicles consisting of nonionic surface-active agent, cholesterol and cholesteryl ester. The firstly stabilized retinol(vesicle) is subsequently inserted into sphingosomes (a kind of multi lamellar liposome) consisting of lecithin and ceramide. Finally the double-encapsulated retinol (sphingosome) is inserted into lamellar liquid-crystal emulsifying base, thereby being triply encapsulated.

(12) **United States Patent**
Lee et al.

(54) **COSMETIC MATERIAL CONTAINING TRIPLE- ENCAPSULATED RETINOL**

(75) Inventors: **Seung Ji Lee**, Chungcheongnam-do (KR); **Byoung Kee Jo**, Kyungki-do (KR); **Young Jin Lee**, Chungcheongnam-do (KR); **Chun Mong Lee**, Chungcheongnam-do (KR)

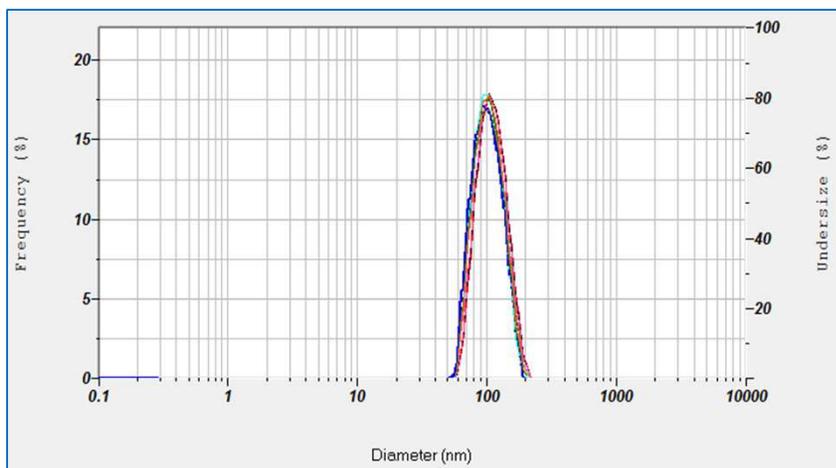
“Retinol contained in the core space of the vesicle which has a mean diameter of 10~50nm”...

Ingredients : Retinol (liposome)

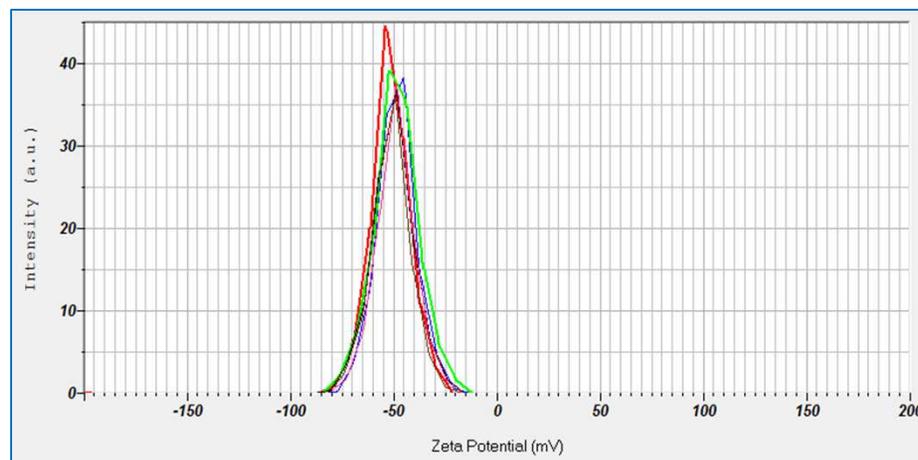
Useful for improving skin health

Liposome Size & Stability

Nanoparticle Size



Zeta Potential



Calculation Results

Peak No.	S.P.Area Ratio	Mean	S. D.	Mode
1	1.00	98.2 nm	29.6 nm	87.6 nm
2	---	--- nm	--- nm	--- nm
3	---	--- nm	--- nm	--- nm
Total	1.00	98.2 nm	29.6 nm	87.6 nm

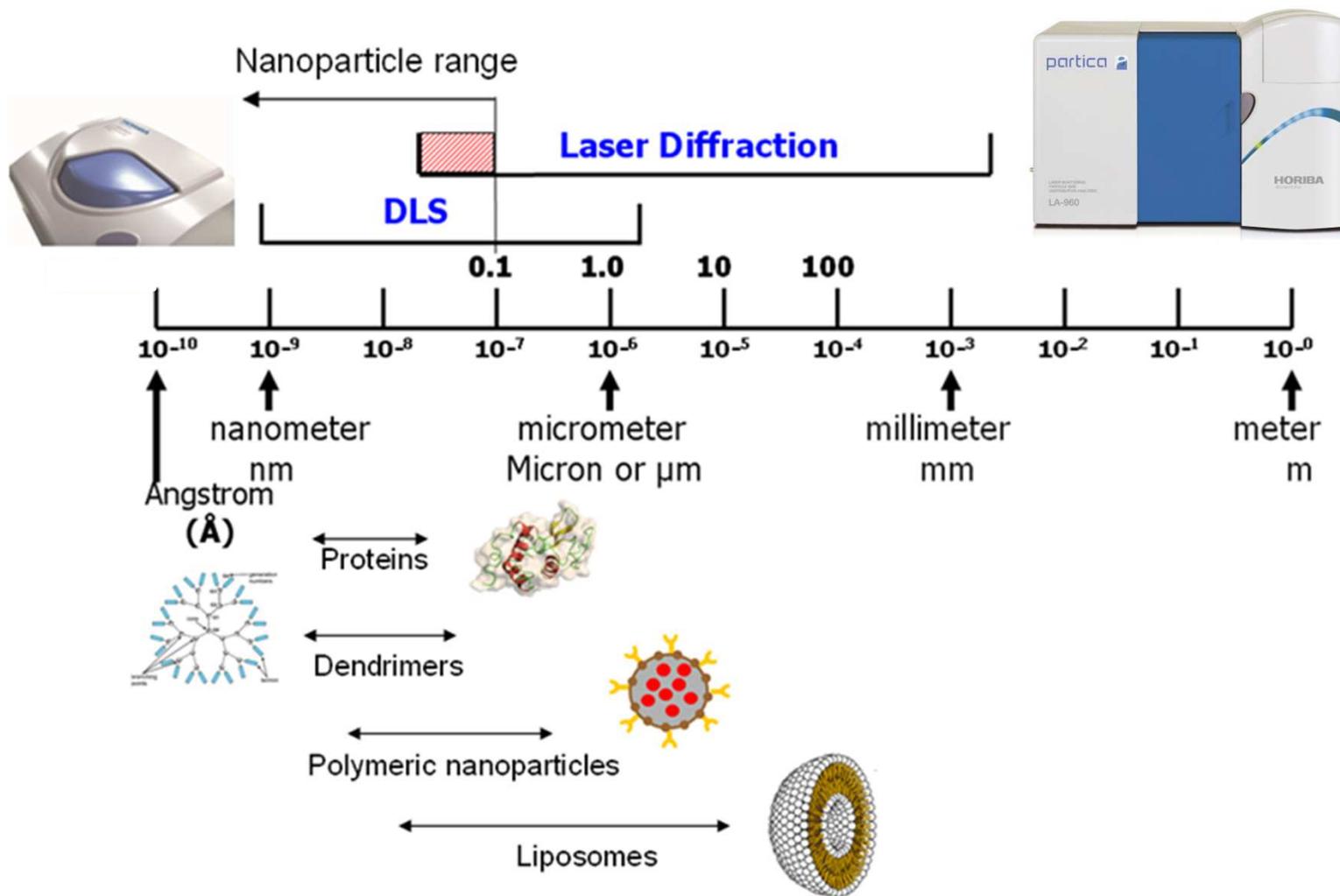
Cumulant Operations
Z-Average : 90.1 nm

Calculation Results

Peak No.	Zeta Potential	Electrophoretic Mobility
1	-48.6 mV	-0.000355 cm ² /Vs
2	--- mV	--- cm ² /Vs
3	--- mV	--- cm ² /Vs

Zeta Potential (Mean) : -48.6 mV
Electrophoretic Mobility Mean : -0.000355 cm²/Vs

Multiple Technologies



Summary

- **Many cosmetic products either powder (particle) based, or contain powders**
- **Widest range of applications measured by laser diffraction**
- **DLS for nanoparticle size and zeta potential**
- **New web page to help determine [best fit for diffraction vs. DLS](#)**
- **Quantify sub-100 nm with either technology**

We'll be attending NYSCC

- **Annual suppliers event May 12-13**
- **Edison, NJ ← HORIBA has an office there**
- **Booth 714**
- **Say hi! to Mitch & Dan**



Thank you

Omoshiro-okashiku
Joy and Fun

おもしろおかしく

감사합니다

Cảm ơn

ありがとうございました

Dziękuję

धन्यवाद

Grazie

Merci

谢谢

நன்ற

ขอบคุณครับ

Obrigado

Σας ευχαριστούμε

اشكر

Tack ska ni ha

Danke Большое спасибо

眞峰


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labinfo@horiba.com

← Receive news of updates

← View application & technical notes (170+), webinars (70+), white papers.

The screenshot shows the HORIBA Scientific website for Particle Characterization. The main content area includes a section titled 'Particle Characterization' with a sub-section 'Particle Characterization Products'. This section describes the instruments and their capabilities, mentioning techniques like laser diffraction and dynamic light scattering. A sidebar on the left provides navigation options, and a sidebar on the right offers ways to request information, download eBooks, and receive newsletters. A 'Member login' section is also present at the bottom right of the main content area.