Explore the future

HORIBA Scientific

HORIBA Instruments Incorporated

Particle Characterization

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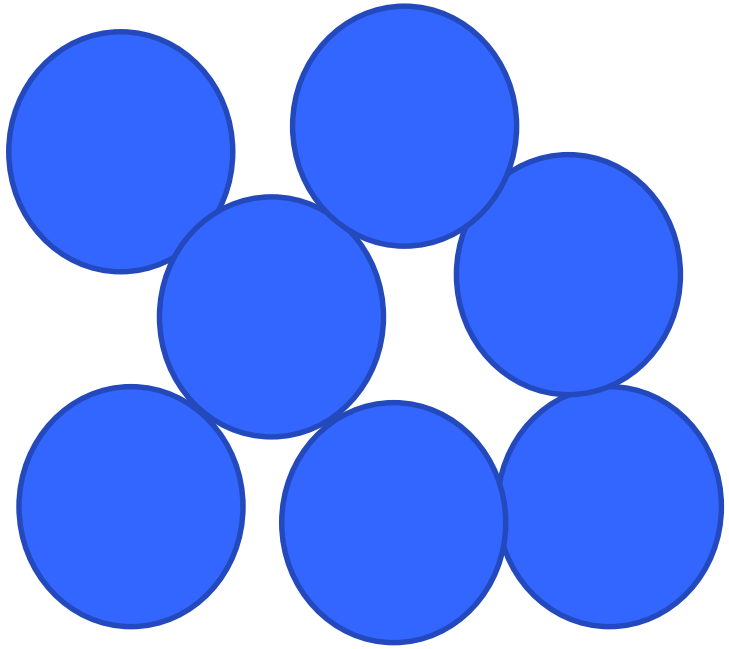
The Ultimate LA-960V2 Virtual Demonstration: Ceramics Powder

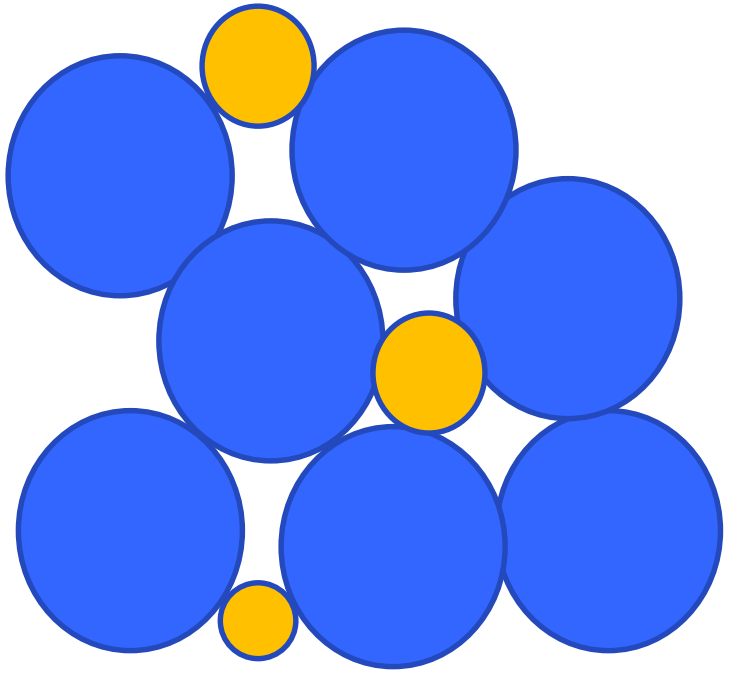
Nov. 18, 2020

Particle size distribution affects:

- Packing density (wider distribution tends to give a higher density)
- Slurry viscosity
- Die filling/compression (fill speed)
- Green strength
- Extrusion performance (scratch in line from large particles)
- Defects in finished parts

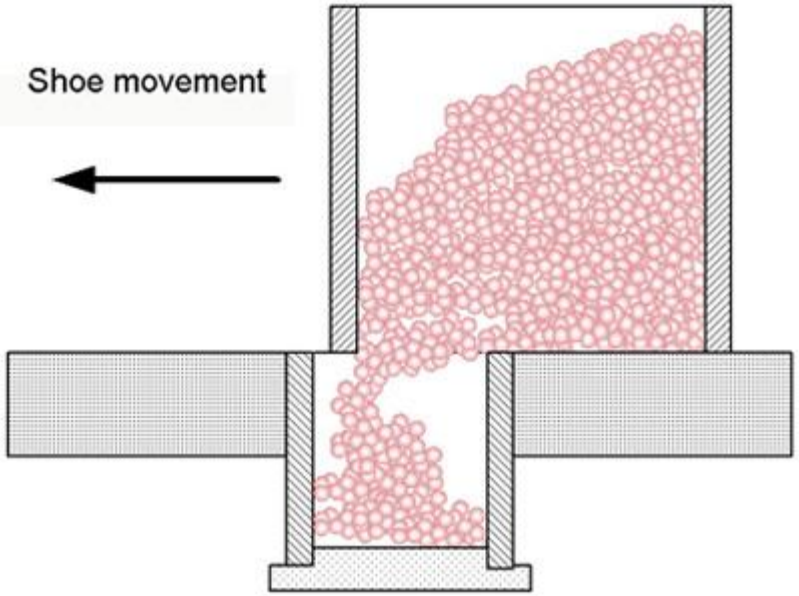
Packing Density





Affects strength and defects of green and finished parts

Die Filling



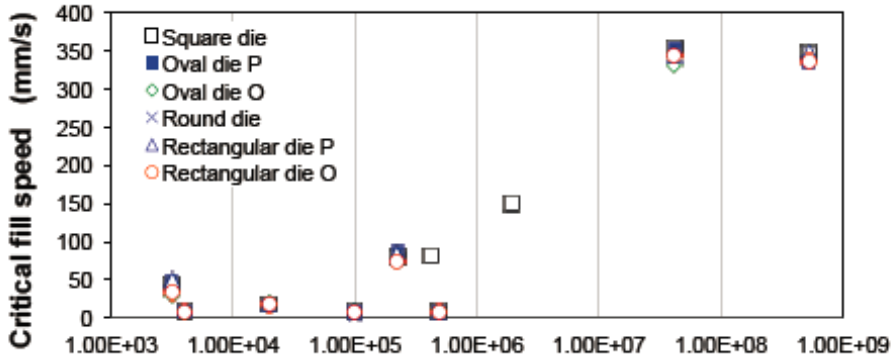
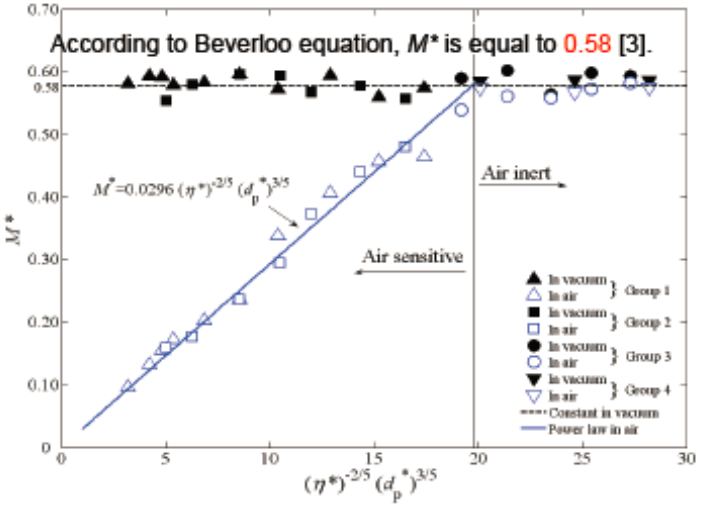


Fig. 10 Critical fill speeds for all cases considered



Dimensionless mass flowrate

$$M^* = \frac{\bar{M}}{\rho_b g^{1/2} b^{3/2} l}$$

Dimensionless air viscosity

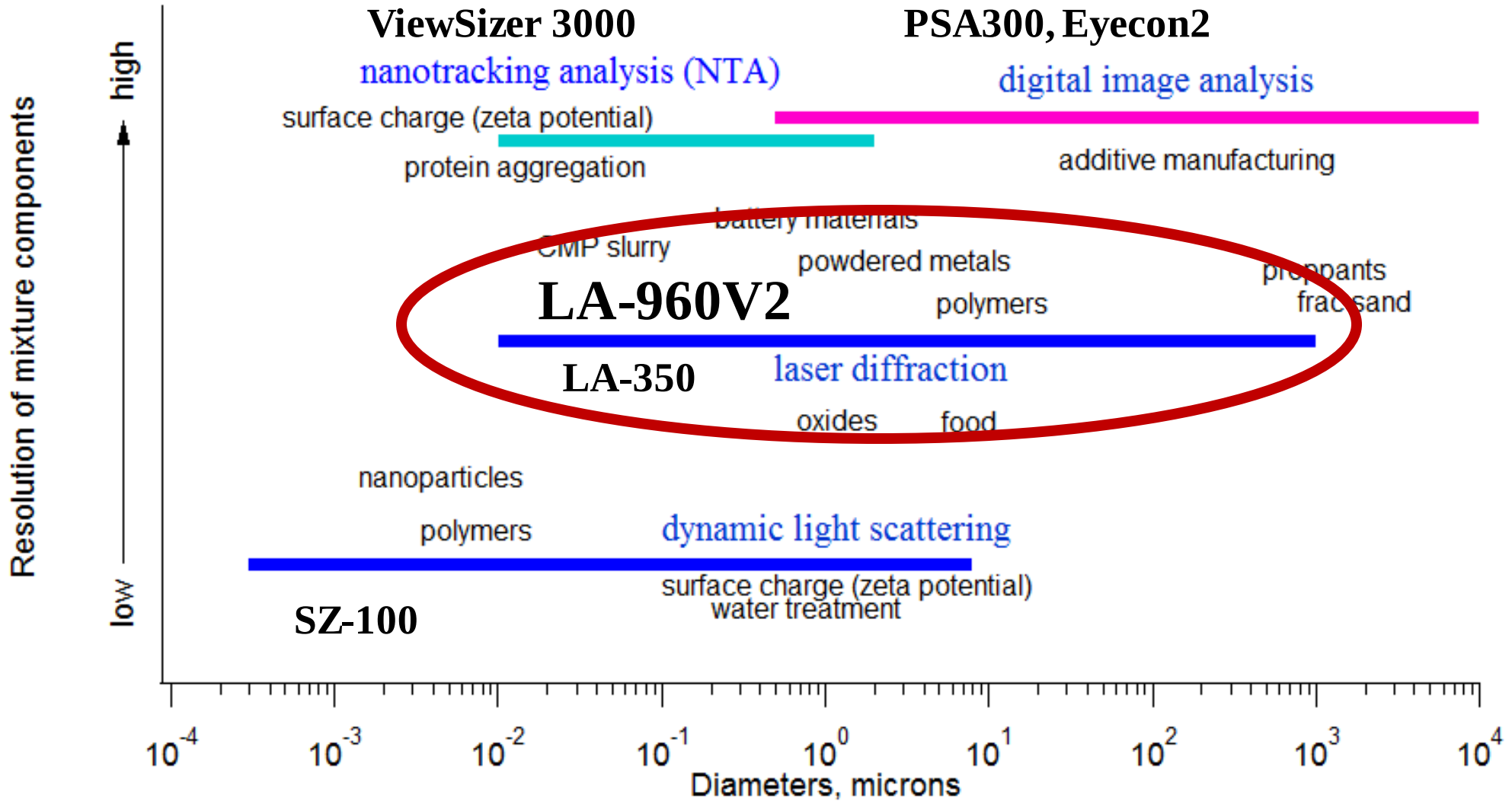
$$\eta^* = \frac{\eta}{\rho_b g^{1/2} b^{3/2}}$$

Dimensionless particle size

$$d_p^* = \frac{d_p}{b}$$

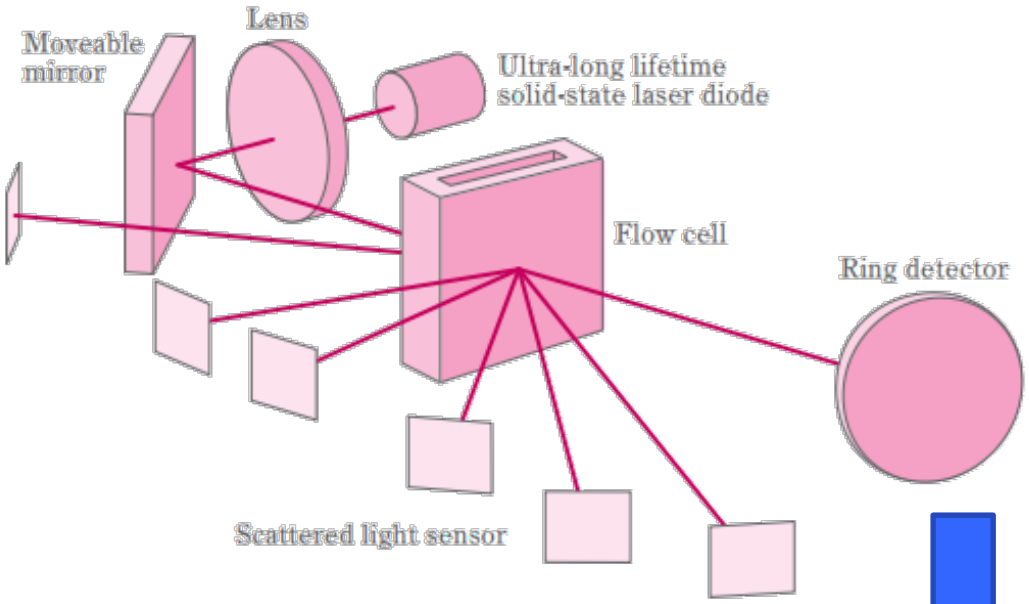
Fig. 11 Dimensionless mass flowrate for die filling in air and in a vacuum (Guo et al. 2009).

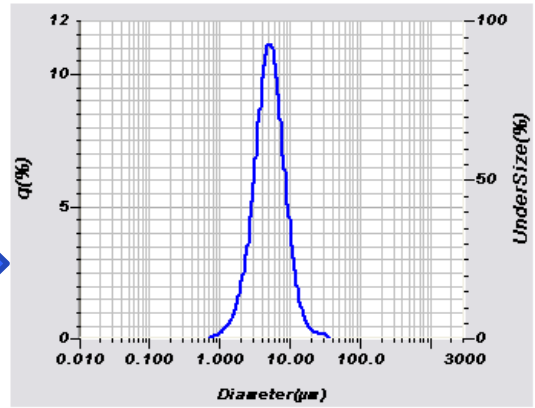
Size range



Laser diffraction

Investigate a particle with light and determine its size

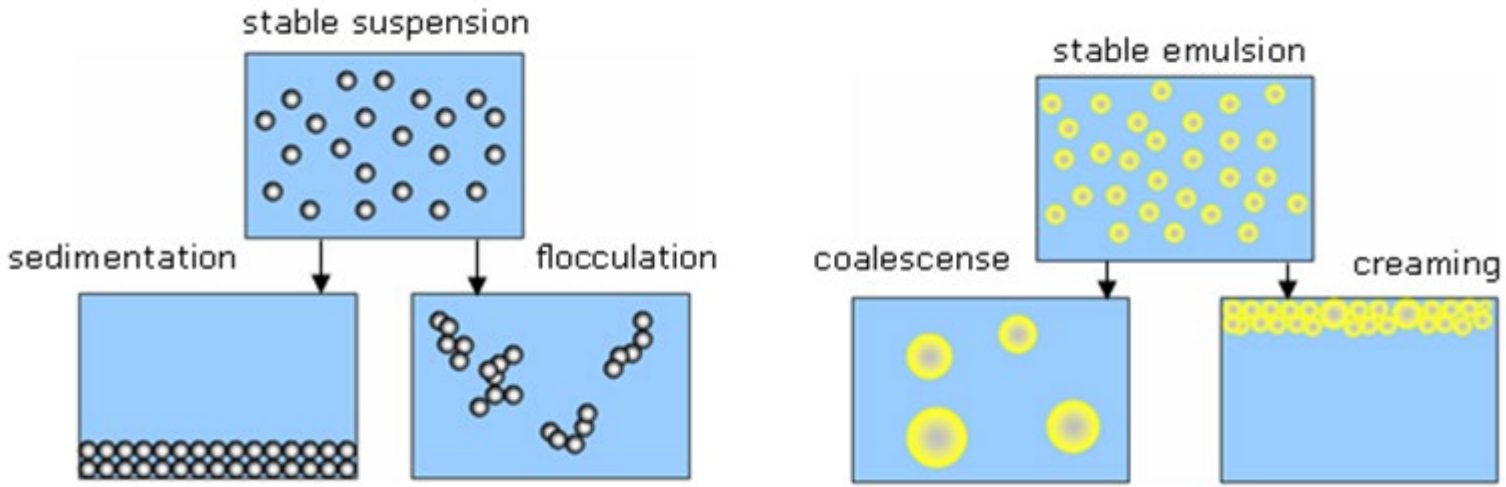




Measurement Workflow

Prepare the sample

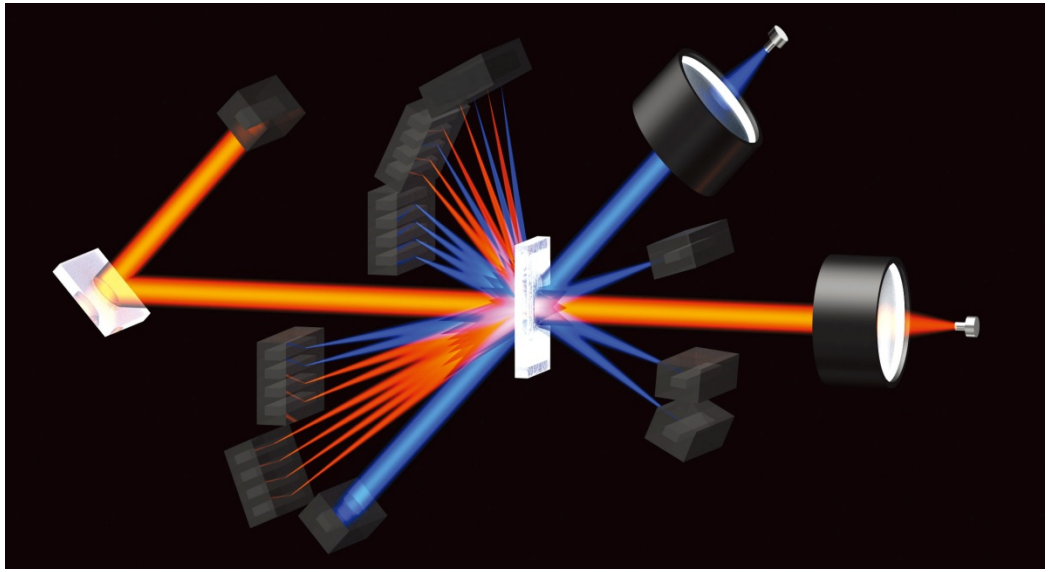
- Good sampling and dispersion a must!
- May need to use surfactant or admixture



Measurement Workflow

Prepare the system

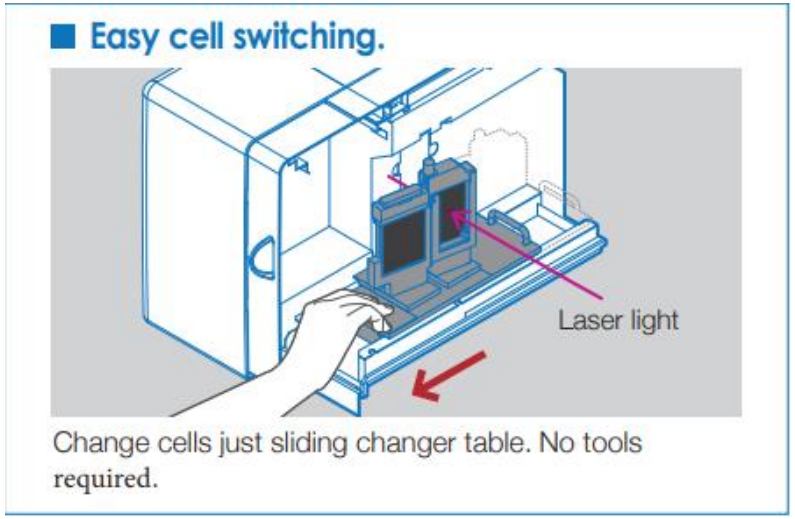
- Align laser to maximize signal-to-noise
- Acquire blank/background to reduce noise



Method Workflow

- Determine particle refractive index (RI)
- Choose diluent (water, surfactants, hexane, etc.)
- Sampler selection: sample volume
- Pump & stirrer settings
- Concentration
- Measurement duration
- Does the sample need ultrasound?
  - Document size-time plot
  - Disperse sample, but don’t break particles
  - Check for reproducibility

Accessories for wet analysis



Flow Cell

Volume (mL)	**180 – 250**
Range (µm)	**0.01 – 3000**

Mini flow

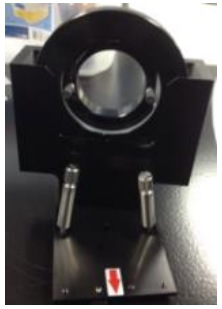
Volume (mL)	**35**
Range (µm)	**0.01 – 1,000**

Fraction Cell

Volume (mL)	**5 – 15**
Range (µm)	**0.01 – 3000**

Paste Cell

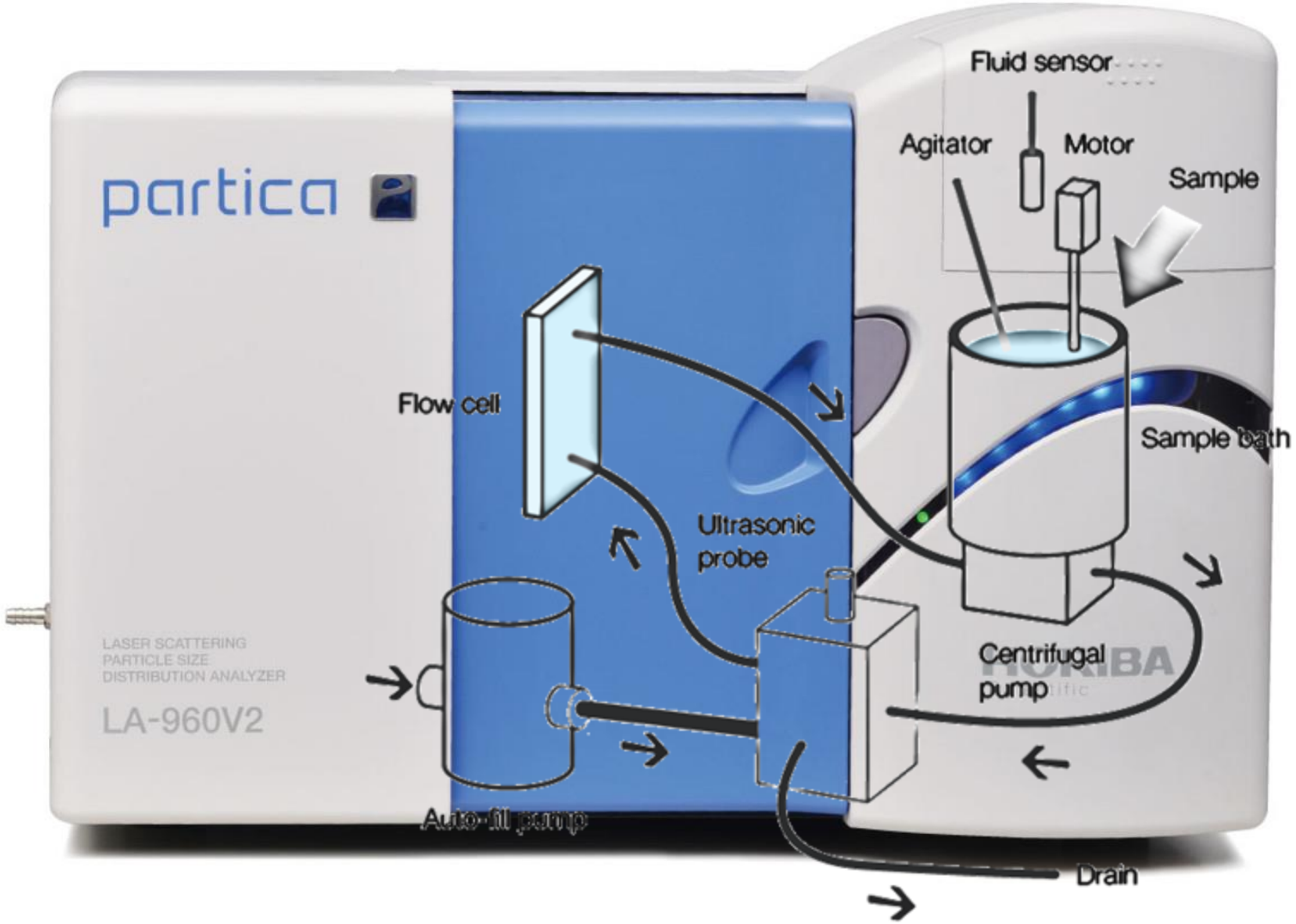
Volume (mL)	**~0.3**
Range (µm)	**0.01 – ~500**



HL Cell

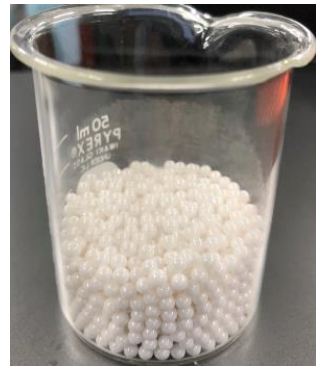
Volume (mL)	**0.5 – 2 mL**
Range (µm)	**0.01 – 500**

Standard circulation



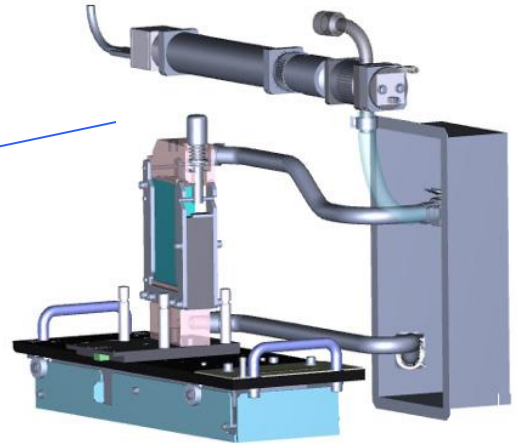
Circulate dense 3 mm particles.

Why? Because we can…



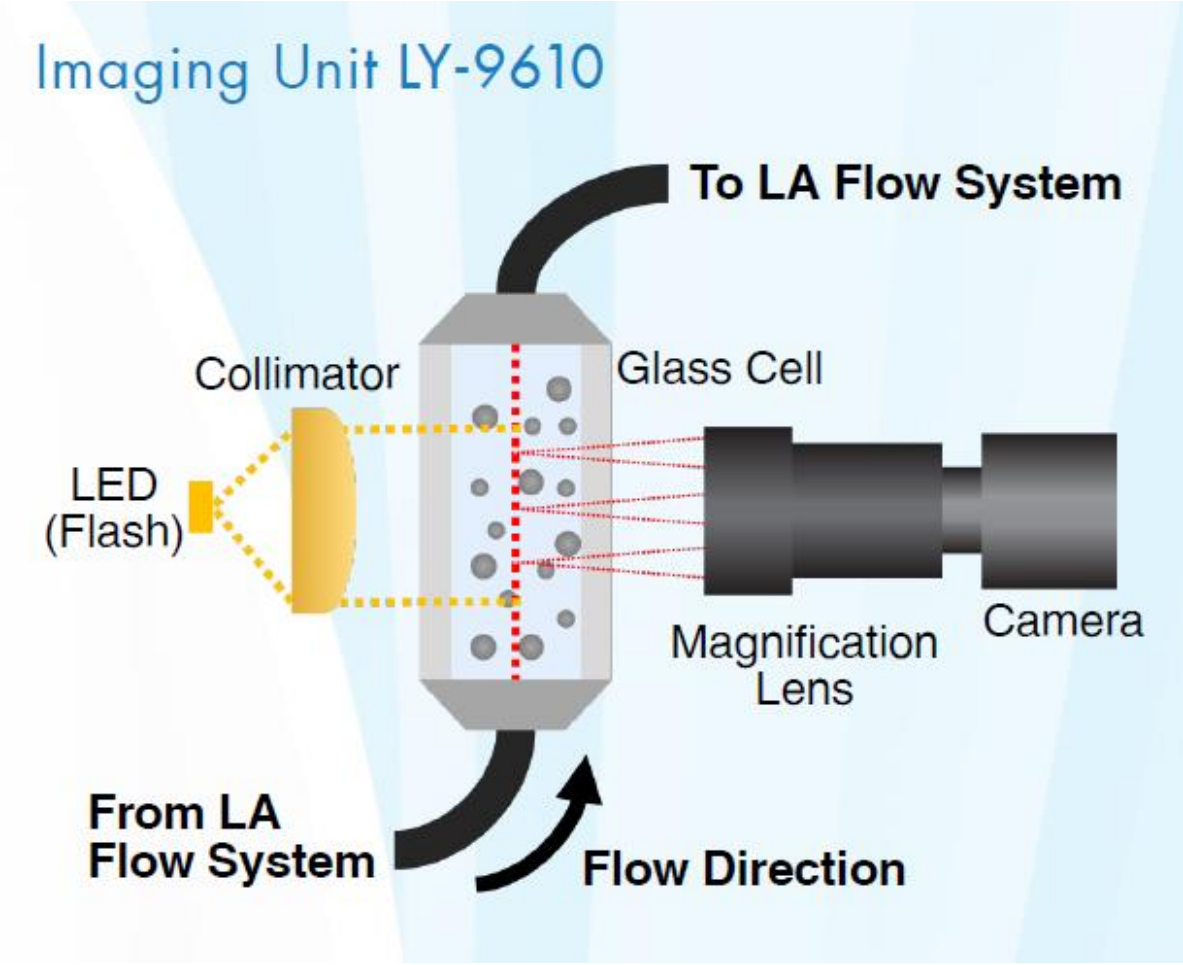
※Ceramic Zirconia 3mmΦ

Imaging option



Integrated Module!

Imaging



Size Range: 9-1000 microns

Pixel Size: 0.73 microns

Dry powder analysis

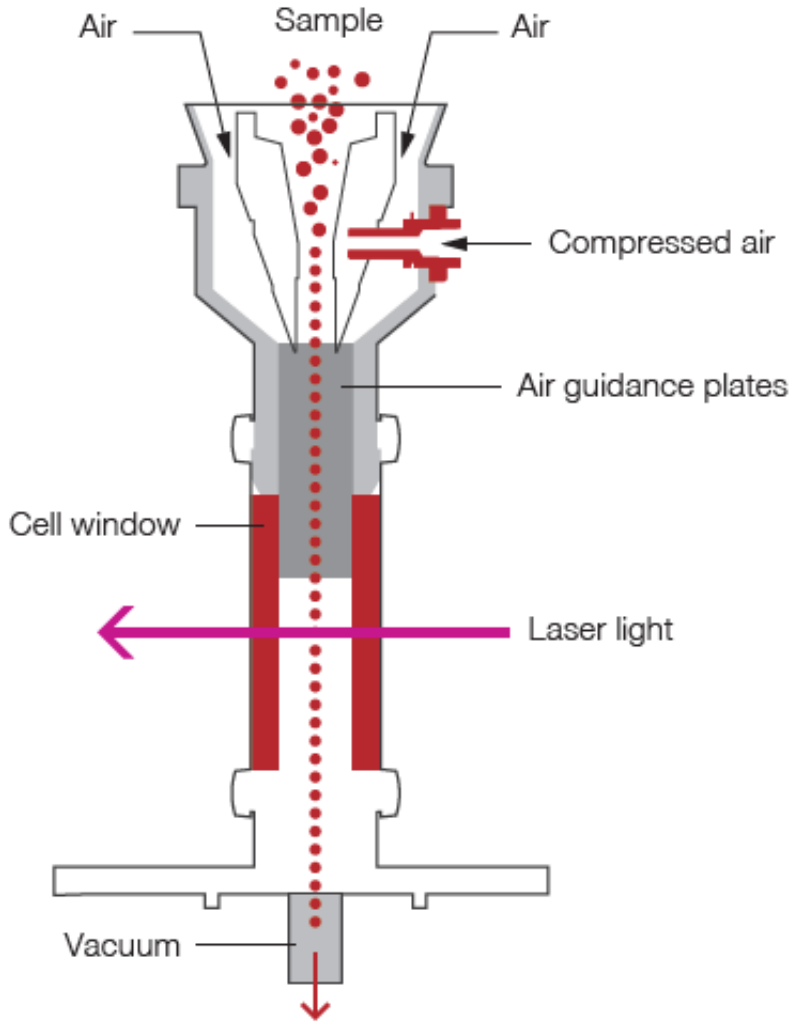
Powderjet Dry Powder Feeder

Dry Unit

Pressure (MPa)	**0 – 0.4**
Ranger (µm)	**0.1 – 5,000**

Dry powder feeder

- Direct flow of powder straight down
- Adjustable air pressure for dispersion.
- No impact surfaces means good dispersion w/o comminution.
- Feedback control gives great reproducibility.
- As little as 5 mg of sample.



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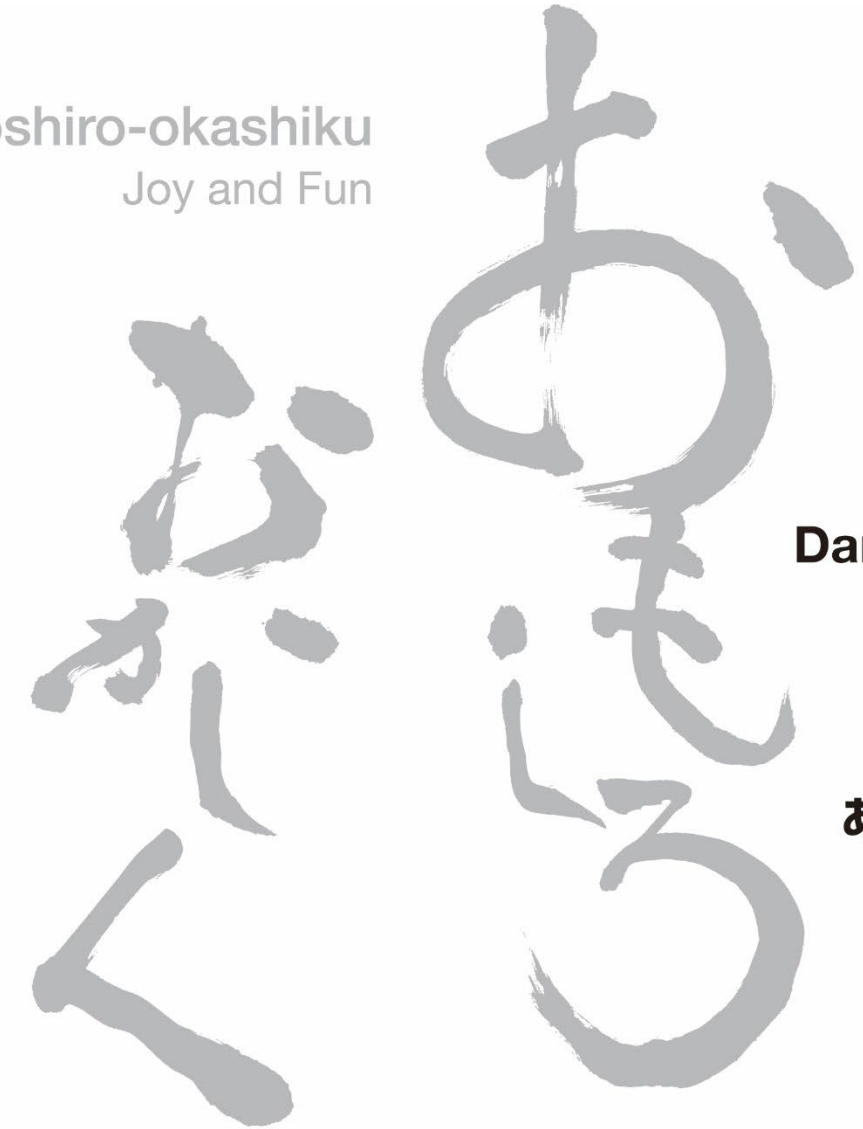
Thank you

Omoshiro-okashiku

Joy and Fun



Terima kasih

Gracias 谢谢

Σας ευχαριστώ πάρα πολύ

Danke Tack ska du ha Grazie

THANK YOU

ขอบคุณครับ Obrigado Большое спасибо

ありがとうございました Cảm ơn Merci 감사합니다

Dziękuję