HORIBA

Explore the future

HORIBA Instruments Inc.

Scientific

Kiwan Park

Pondering Piezo Particles

5/10/2016

What we'll talk about today

- **Fun Facts**
- **The Fundamentals**
- **Applications**
- **The How's**
  - How is Lead Zirconate Titanate (PZT) manufactured?
  - How is particle sizing crucial?
    1. Lead (IV) Oxide
    2. Lead (II) Oxide
    3. Lead Zirconate
    4. Lead Zirconate Titanate (PZT): soft and hard
- **Q&A**

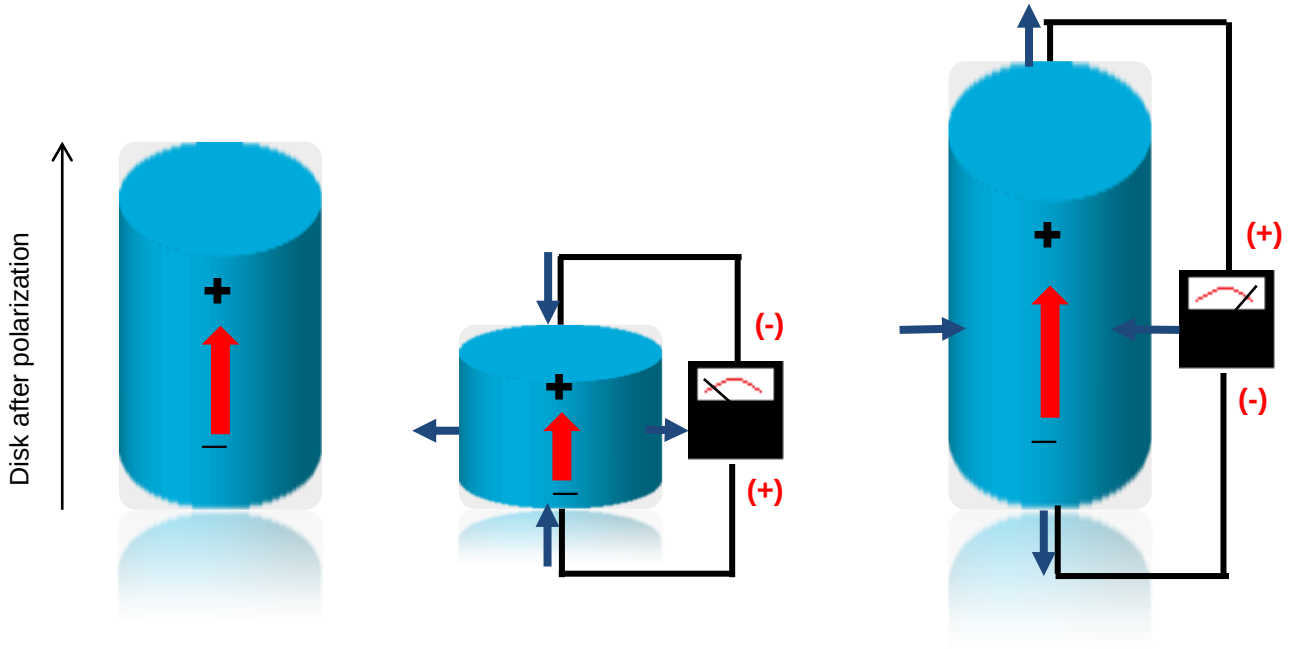
Fun Facts

- "**Piezo**", derived from the Greek *piezein*, which means to squeeze or press
- It's pronounced as pee-eh-zo, it has nothing to do with a pie

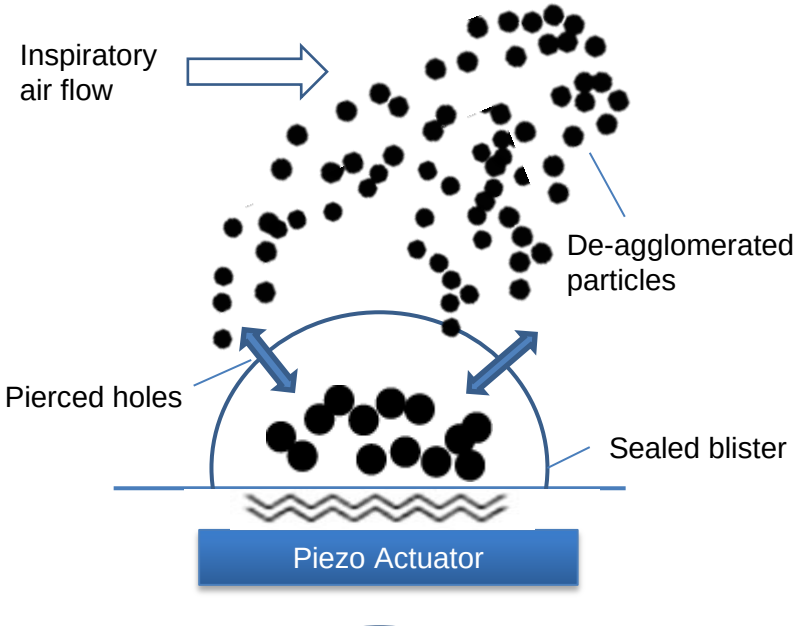
- **Piezoelectricity** was discovered in 1880 by French physicists Jacques and Pierre Curie.
- **Radioactivity** was discovered by Marie Curie, Pierre Curie's wife
- 5 Nobel Prizes

The Fundamentals

- **Direct piezoelectric current**
- **Inverse piezoelectric current**
- **Cyclic**



Application – DPI



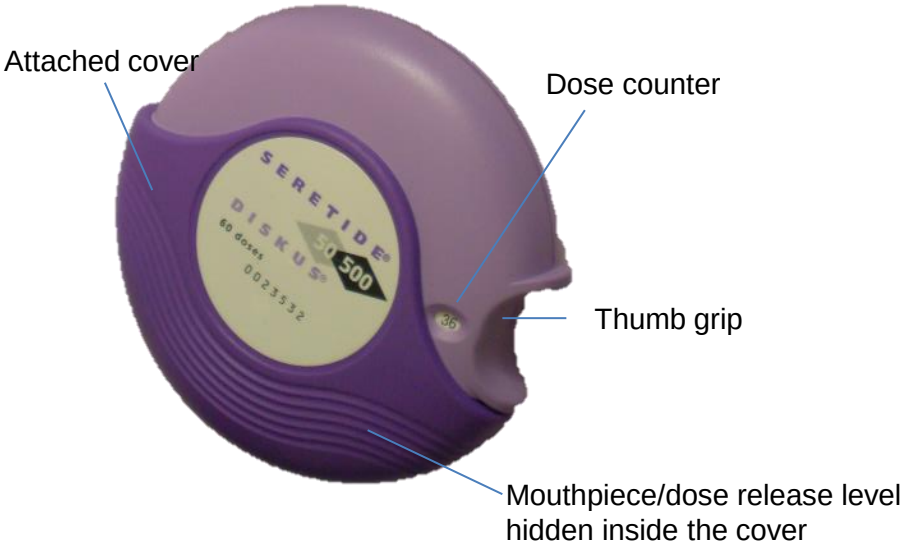
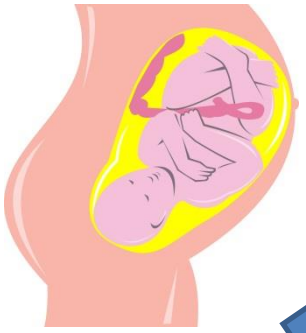
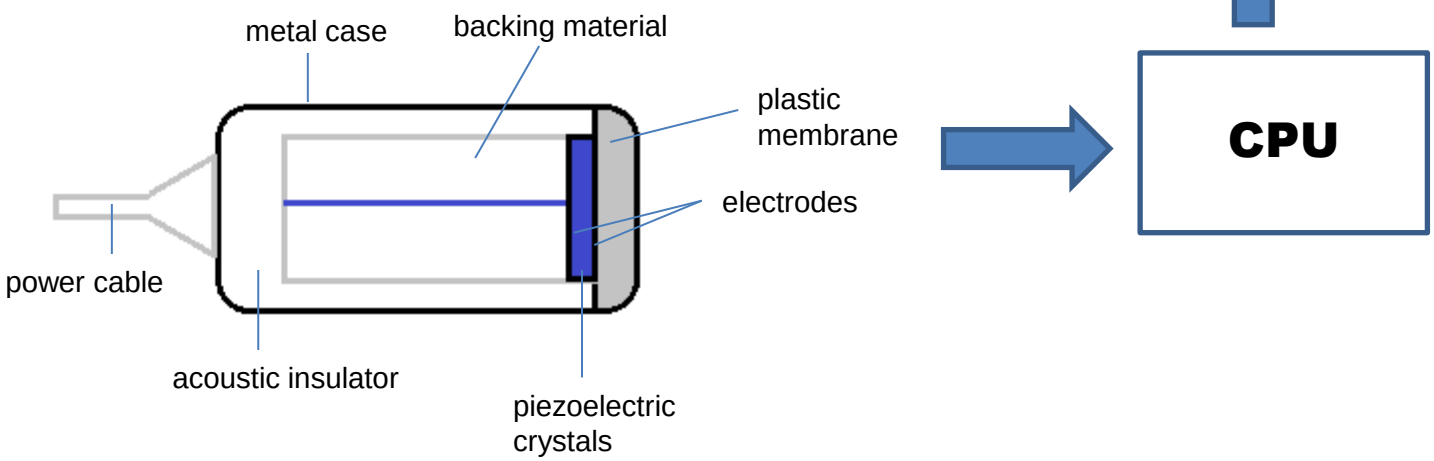


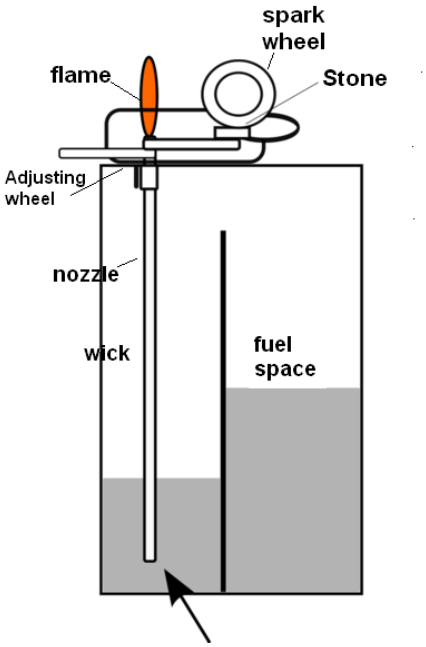
Image source: https://upload.wikimedia.org/wikipedia/commons/a/ae/Astma-medication.png

Application – Ultrasound





Application - Igniter



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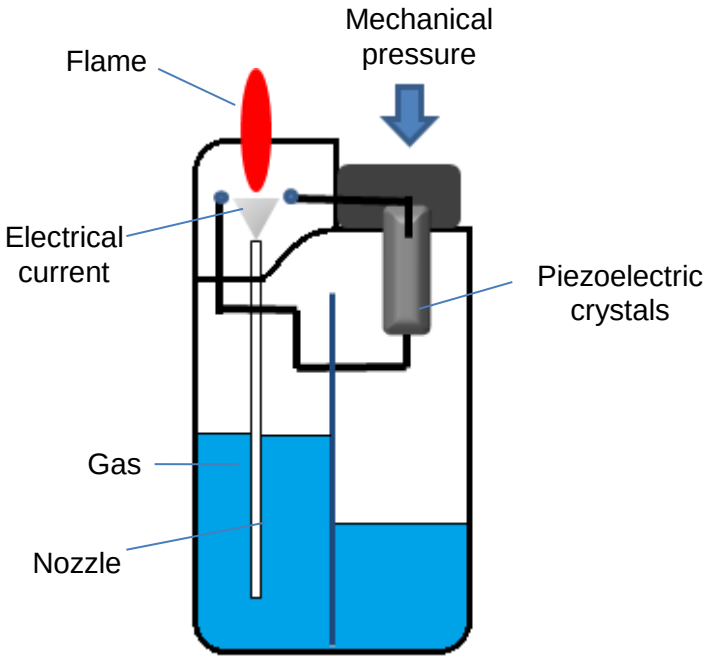
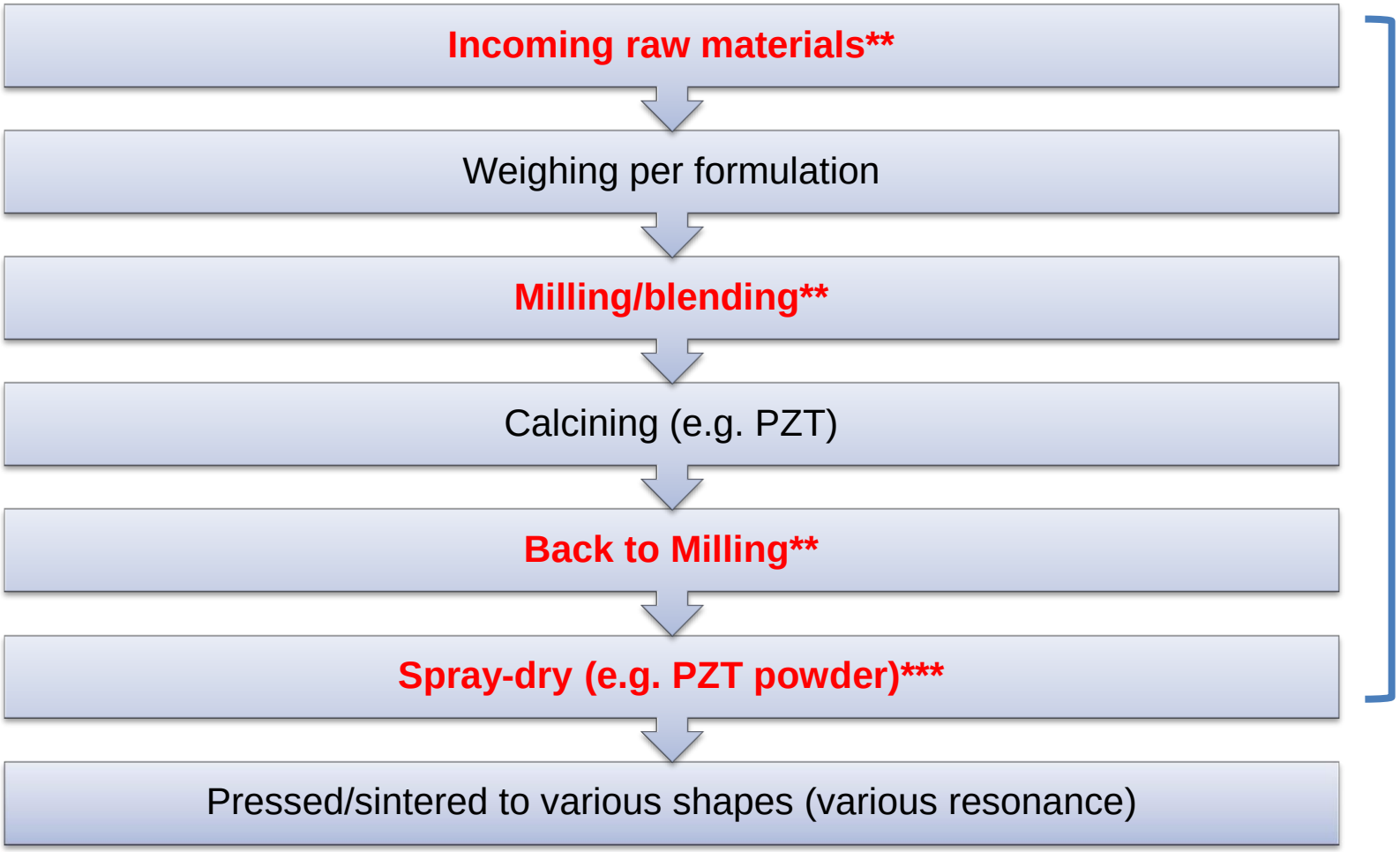


Tire pressure monitoring systems (TPMS) embedded inside

How is PZT manufactured?

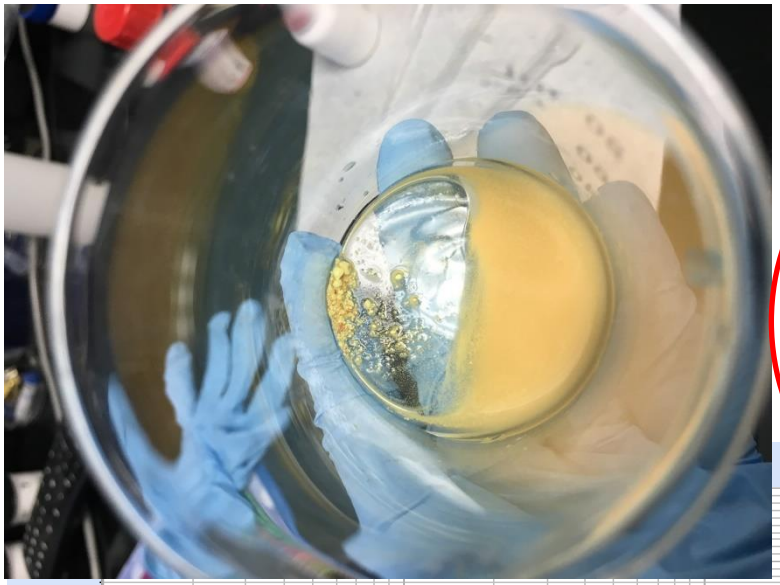


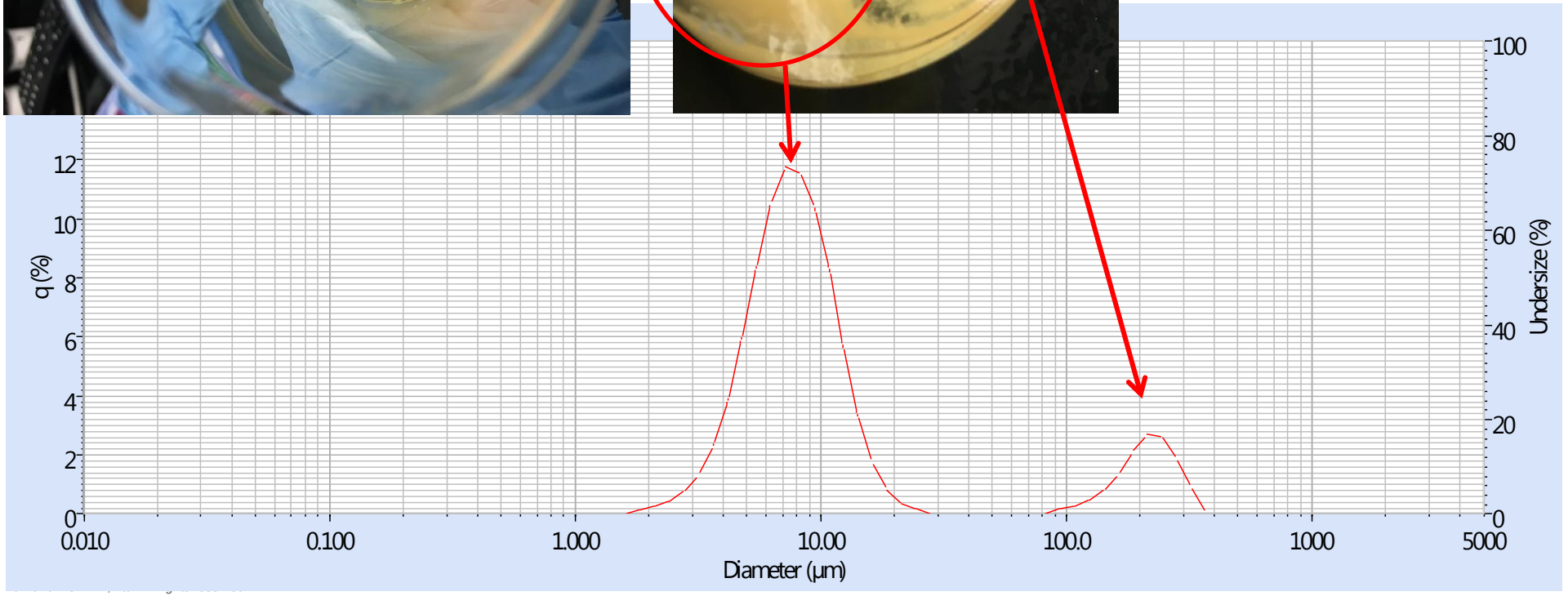
**Particle sizing required | ***Particle size and shape required

Measurement Method

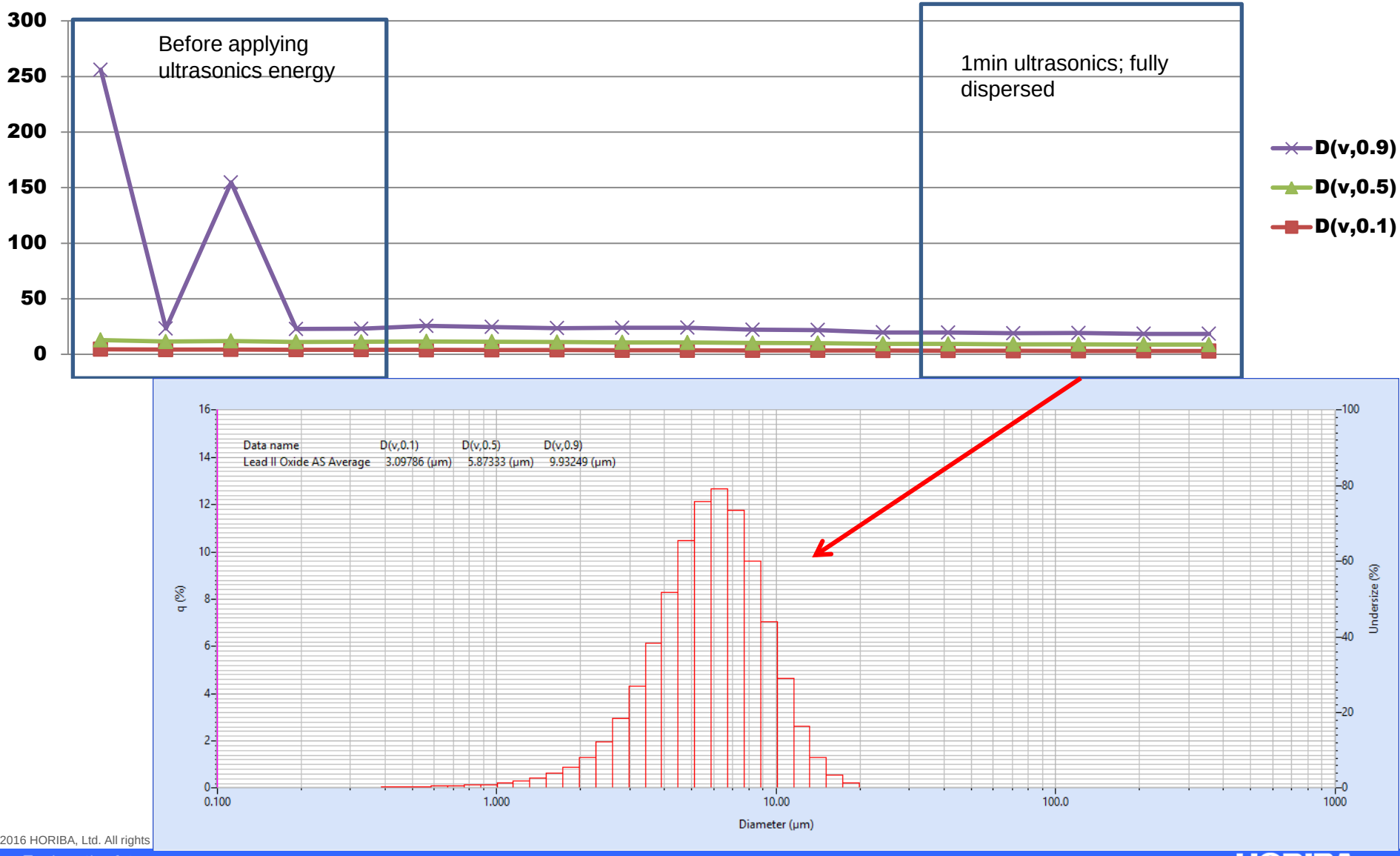
- Laser diffraction
- Mie Scattering theory
- Dispersion method: water with surfactant (e.g. 0.1wt% of Darven C or 0.1wt% of Sodium Pyrophosphate solution)
- Refractive Index @ 650nm: 2.32-3.22
- RI is important for particles <50um (ISO13320)

Lead (II) oxide

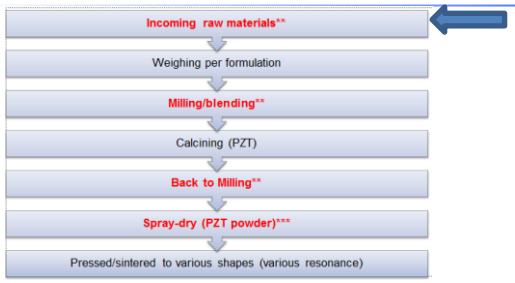


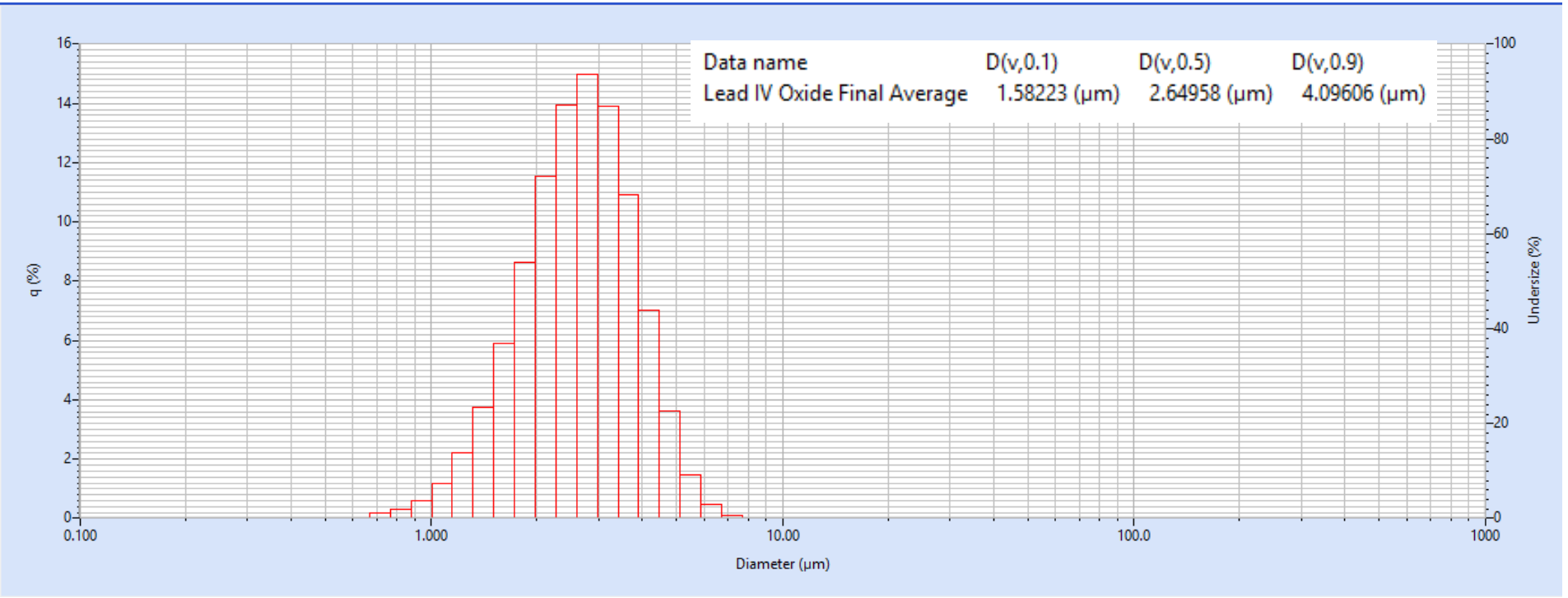


Lead (II) oxide

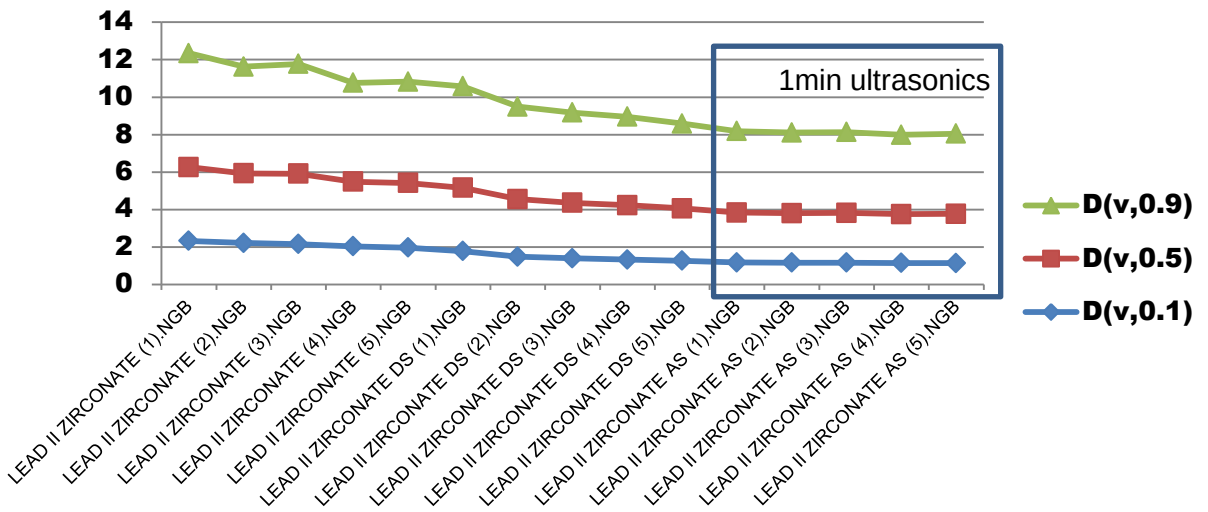


Lead (IV) oxide

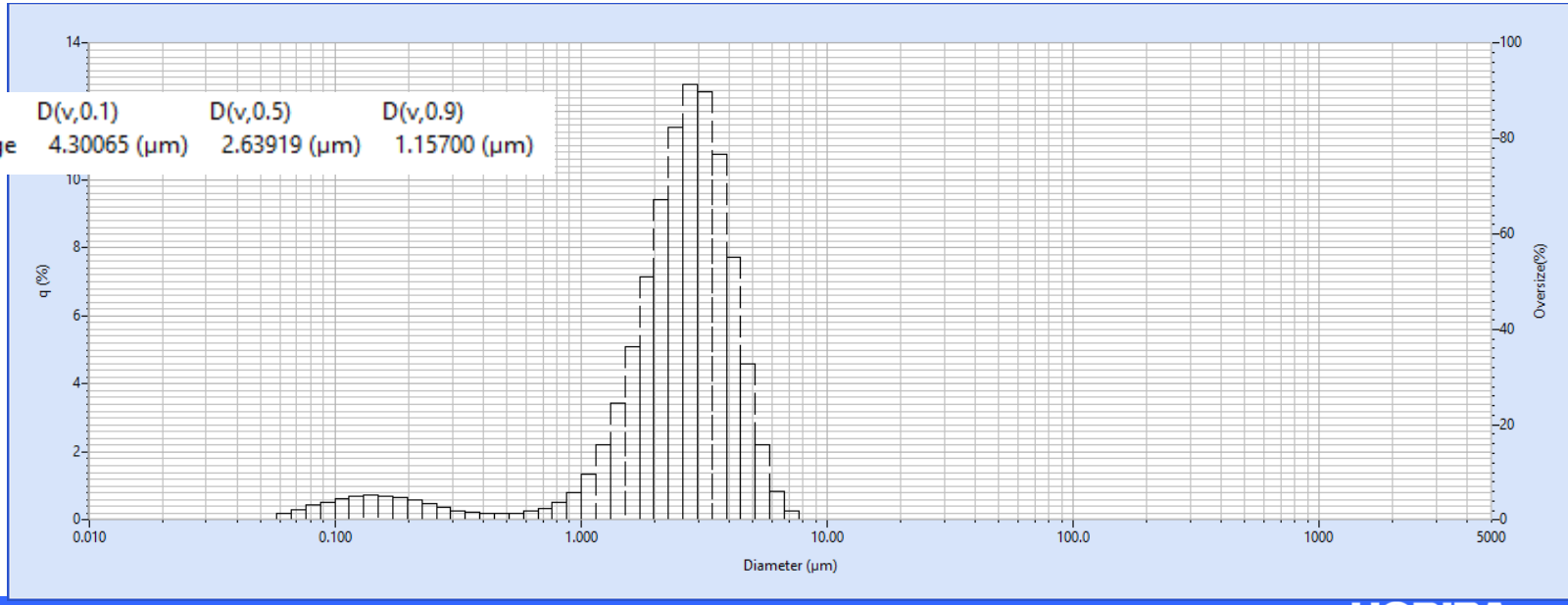




Lead Zirconate



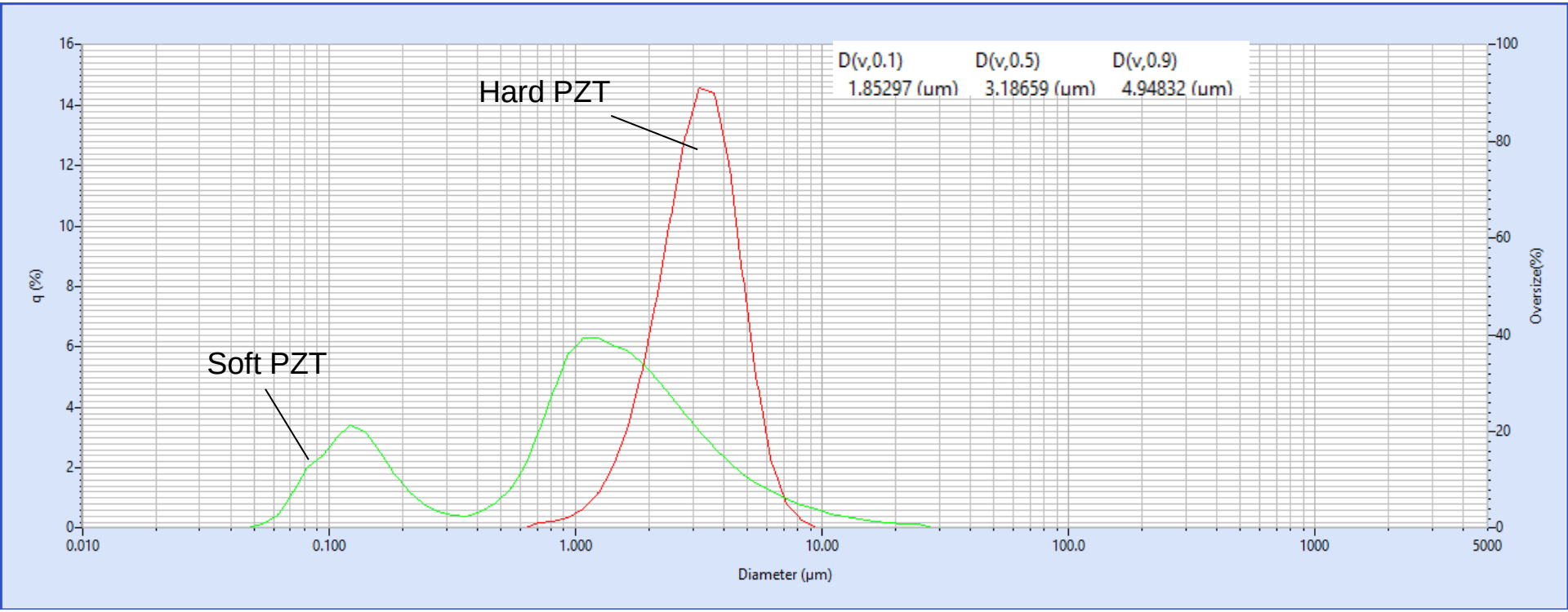
Data name	D(v,0.1)	D(v,0.5)	D(v,0.9)
Lead II Zirconate AS Average	4.30065 (µm)	2.63919 (µm)	1.15700 (µm)



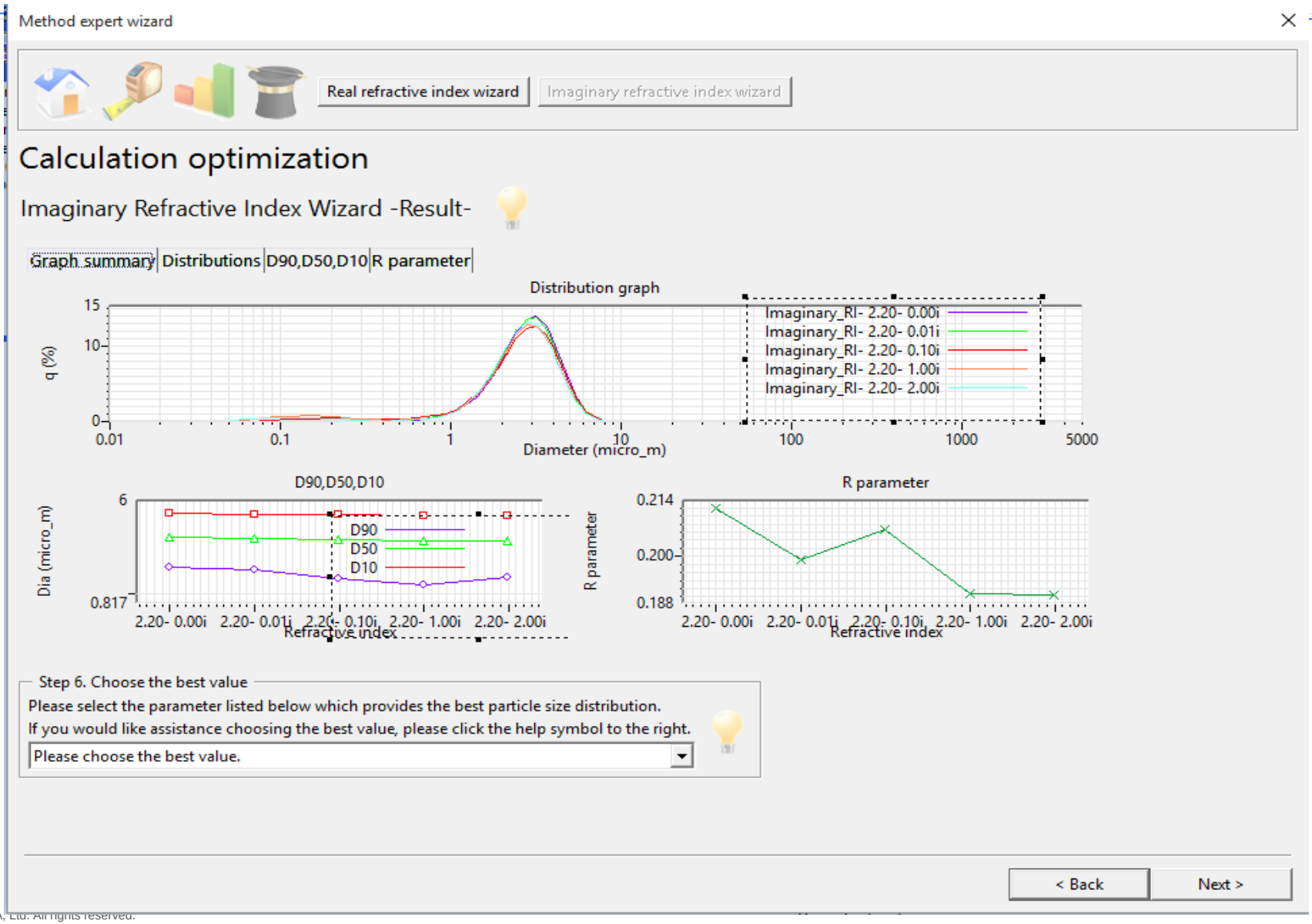
Soft PZT / Hard PZT

- **“Hard” PZT**
  - ✓ “hard” because its dipole or domain is restricted by composition.
  - ✓ Can with stand high electrical, high temperature and mechanical stresses.
  - ✓ Used in applications when high power is required. E.g. welders, ultrasound cleaners.
- **“Soft” PZT**
  - ✓ “Soft” because dipole or domain isn’t restricted by composition
  - ✓ Has high permittivity, high coupling, high Curie temperature.
  - ✓ Used in applications when high sensitivity is required. E.g. medical ultrasound, gas igniters.

Hard PZT



RI Assessment



Acknowledgment

Special thanks to Wayne Lee of Harris Corp for providing general knowledge of the PZT manufacturing process

www.exelispzt.com

Q&A

Email us your questions:

Labinfo@horiba.com

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Thank you very much for your attention.

Thank you

Omoshiro-okashiku

Joy and Fun

眞峰

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

شُكْرا

Tack ska ni ha

Большое спасибо

Danke

Gracias