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Formation of nanosized metal hydrosols under the influence of terahertz laser radiation

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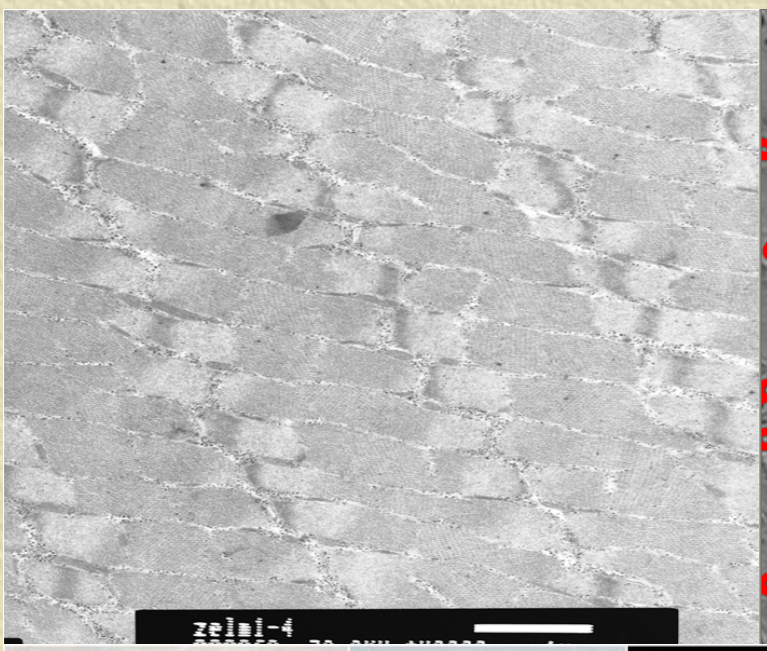
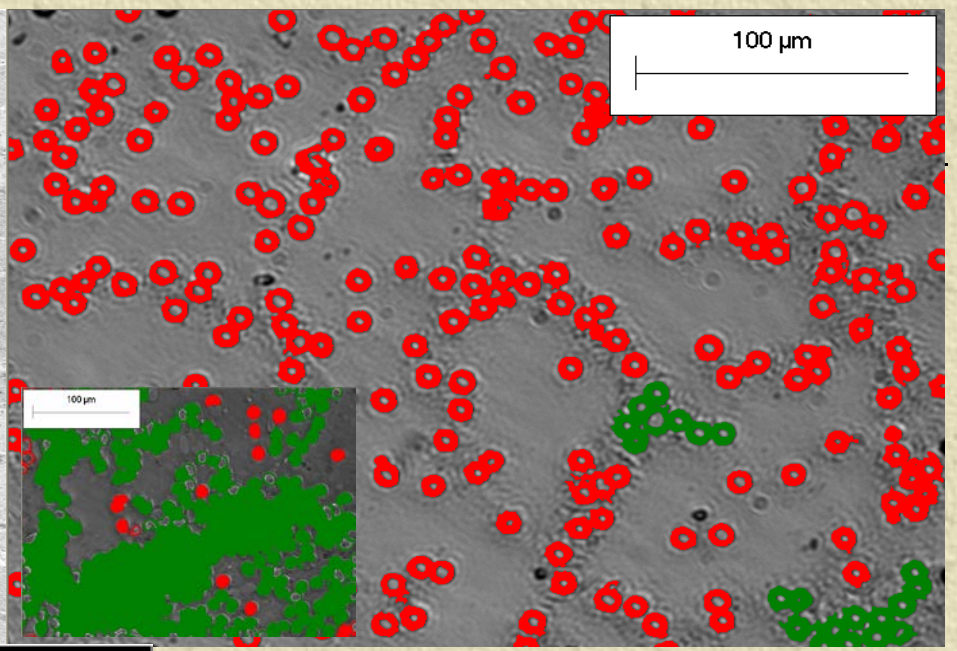
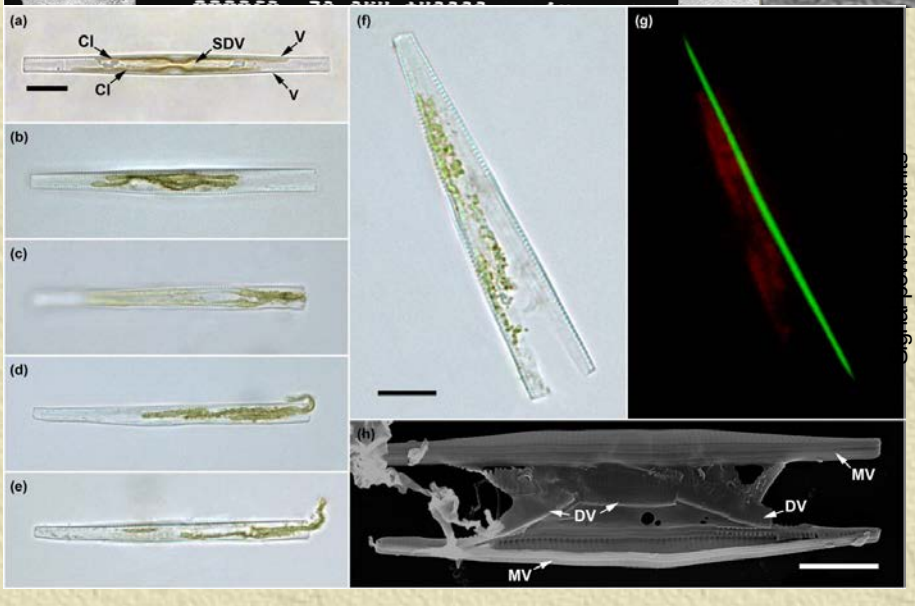
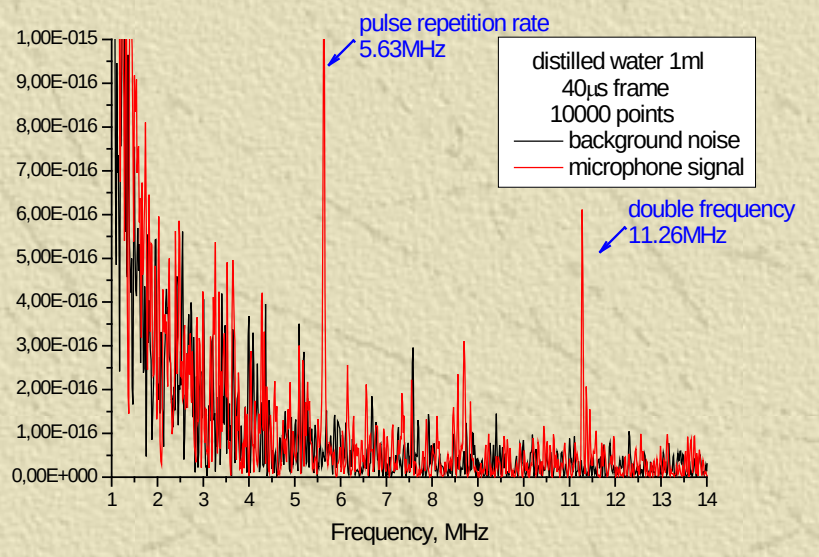
“Mechanical” effect in water suspensions









Conditions, samples and techniques

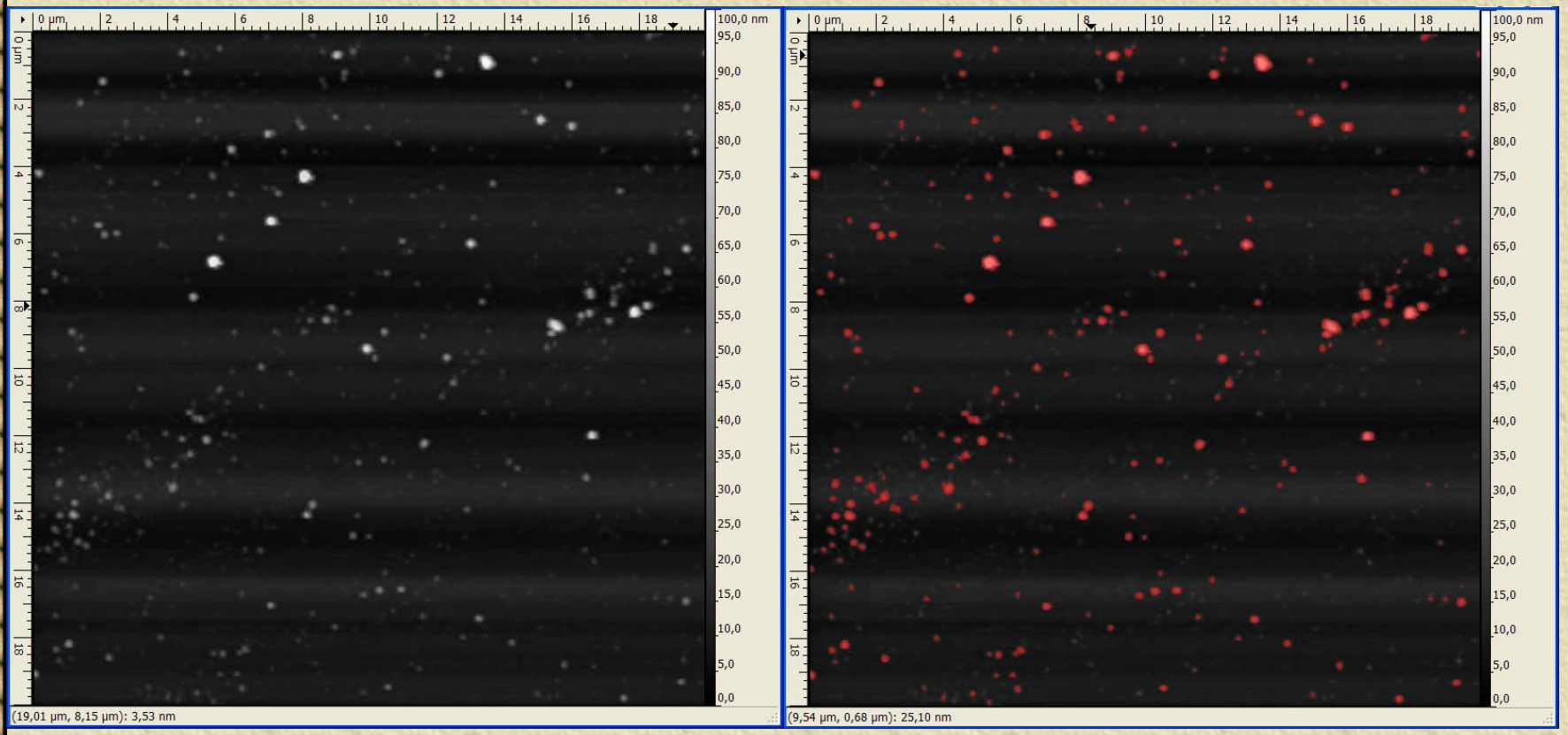
130µm 5.6MHz 20W/cm^2
room conditions

5-10 sec focused
100µl distilled water

hard brass
soft lead

freeze-dried
AFM (tapping)
SEM EDAX
ICP-MS

Counting/sizing



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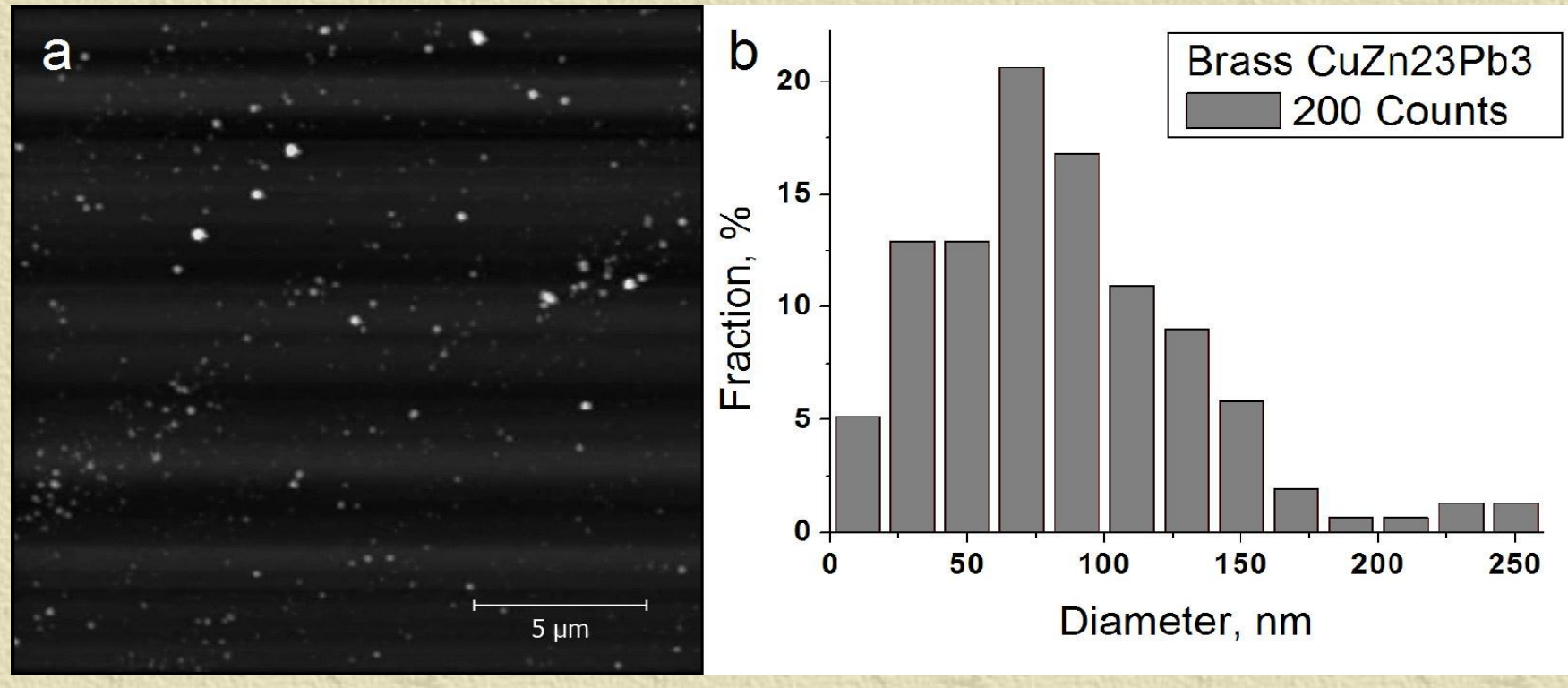
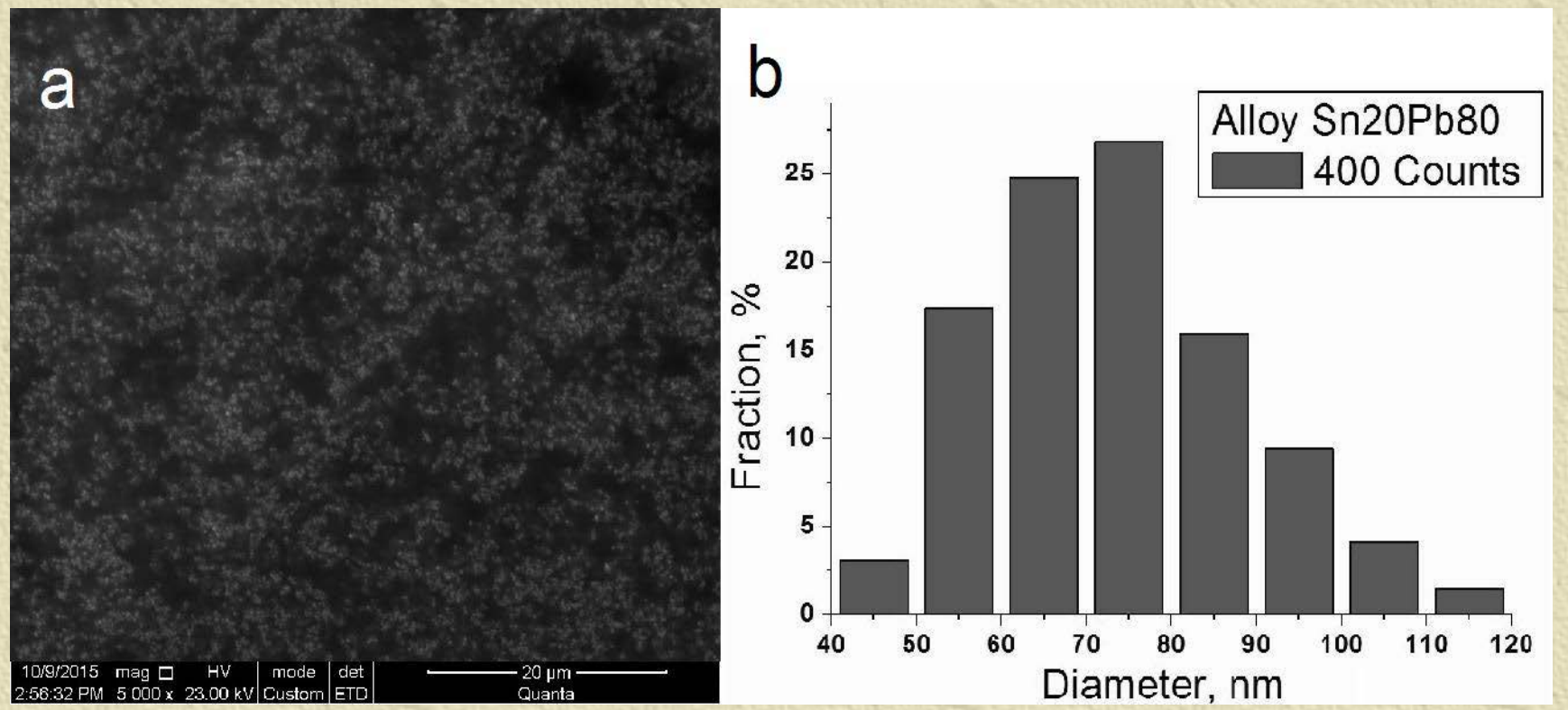
Background flattening -> enhance contrast -> mark at 50% threshold

(a) AFM image of brass CuZn23Pb3 hydrosol particles; and (b) size distribution



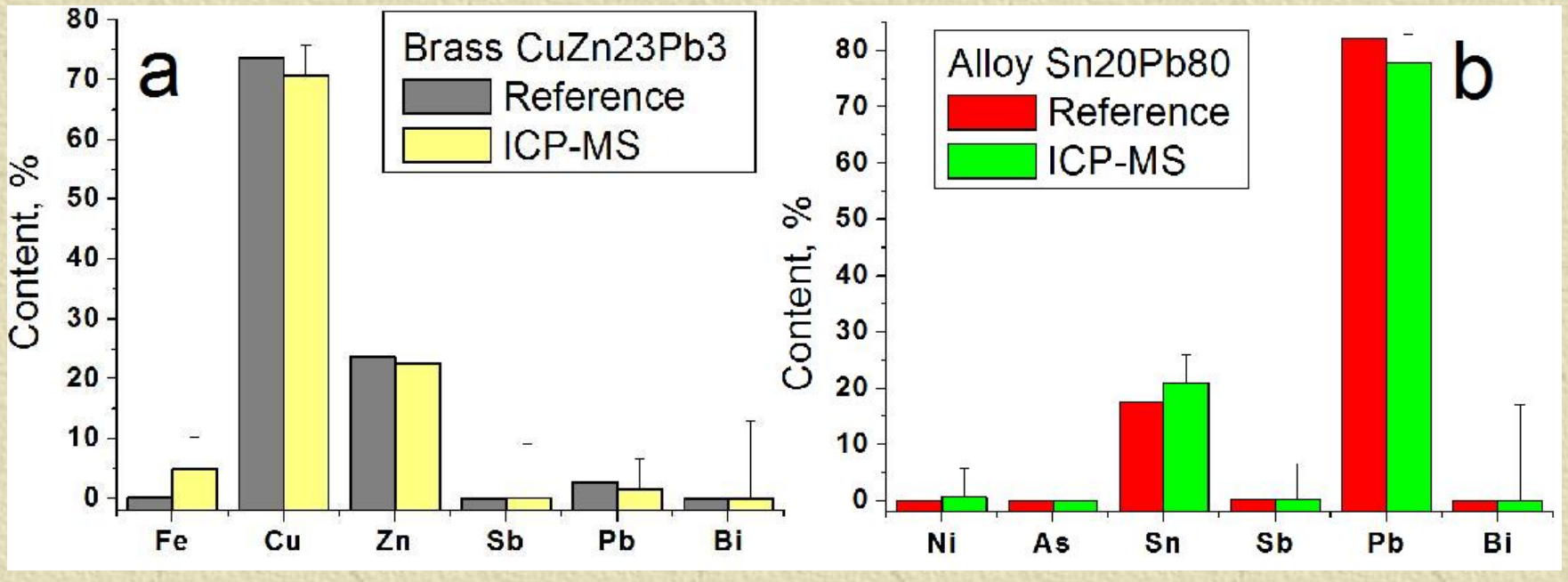
Range 10-250nm, max – 70nm

(a) SEM image of alloy Sn20Pb80 hydrosol particles; and (b) size distribution

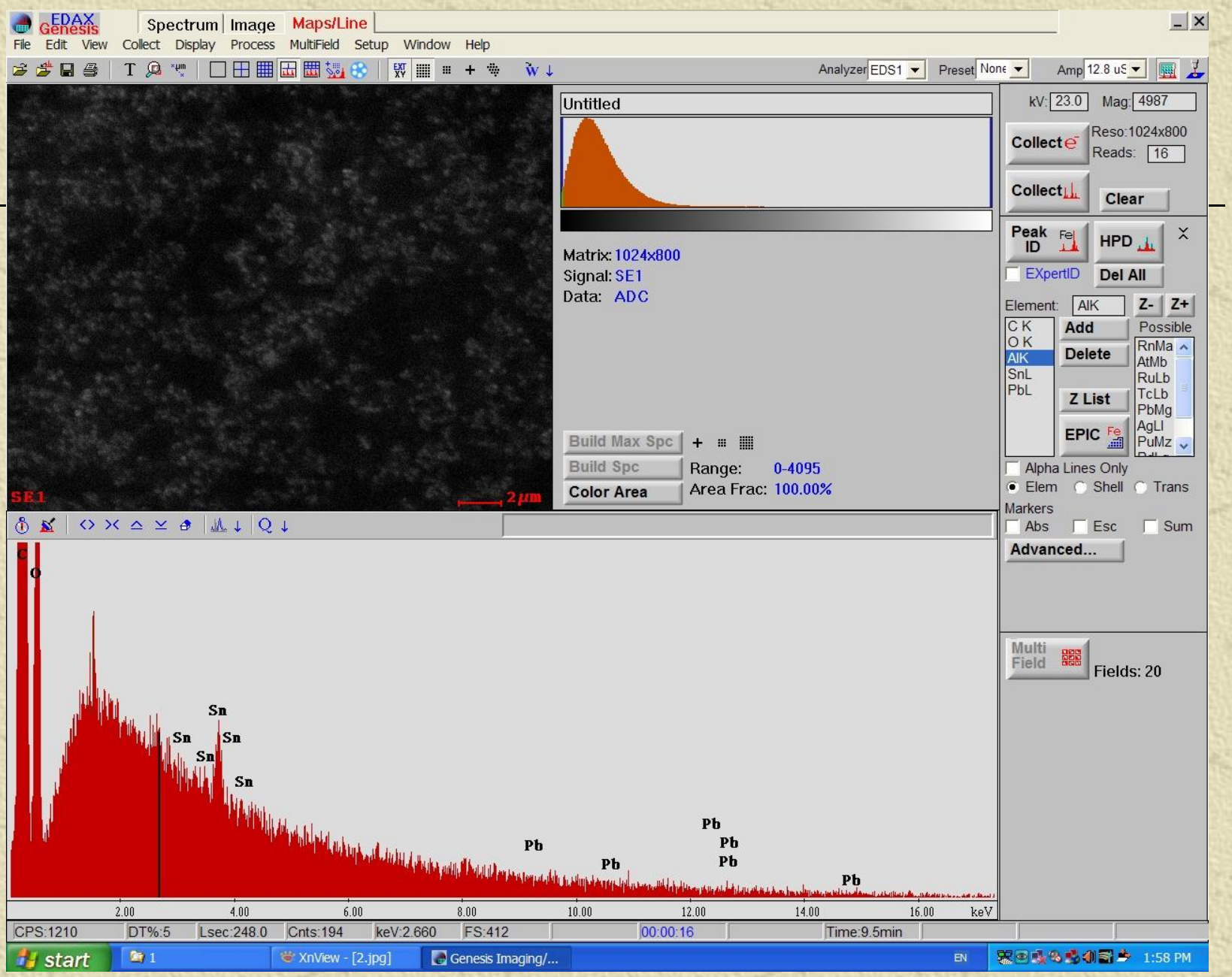


Range 40-120nm, max – 75nm

Elemental analysis



Elemental analysis data (ICP-MS) for nanoparticles and the container materials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File
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Process
MultiField
Setup
Window
Help
Analyzer EDS1
Preset None
Amp 12.8 uS
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Matrix: 1024x800
Signal: SE1
Data: ADC
Build Max Spc
Build Spc
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Range: 0-4095
Area Frac: 100.00%
kV: 23.0
Mag: 4987
Collect
Reso:1024x800
Reads: 16
Collect
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Peak ID
HPD
EXpertID
Del All
Element: AlK
Z-
Z+
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O K
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SnL
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TcLb
PbMg
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PuMz
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Notes

- Plastic containers and THz transparent solvents
  do not lead to the formation of hydrosols

- Graphite and ceramics particles detected
  but not well characterized up to the present

- THz laser generation of hydrosols of certain composition (of anything that might be included into the alloy) under normal conditions can be an alternative to mechanical, chemical, other

- Suitable for catalytic, mechanochemcal applications or as a method of sample preparation for elemental analysis by ICP-MS

- Underway to expand the range of materials and conditions

Summary

- ✓ We are able to generate $10^{10}cm^{-3}$ or 1-2mg/l particles in water
- ✓ Particle size is about 70nm (10-250)
- ✓ Elemental composition is defined by the container material
- ✓ The process is easy and repeatedly reproducible
- ✓Optoacoustic ultrasound is considered as a possible reason

Thank You for attention !