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Size-control laser-based method for the production of gold nanoparticles

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Nanoparticles

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- Properties strongly dependent of size and shape.

- Surface plasmons: strong resonance absorption and scaterring at a particular wavelength.

- Application: medicine (bio-imaging, therapeutics), biology, eletronic devices.

AuNPs

Nanoparticles – production methods

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- Bottom up: atoms are assembled to generate nanostructures.

- Top down: material is removed from the bulk material.

Laser Ablation Synthesis in Solutions

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- A solid gold target is placed on the bottom of a glass vial filled with the desired solvent (deionized water or THF(*Tetrahydrofuran*)).
- Incidence of nanosecond laser irradiation.
- Explosion, vaporization and photoionization of the material.
- Plasma plume and formation of nanoparticles.

Laser Ablation Synthesis in Solutions

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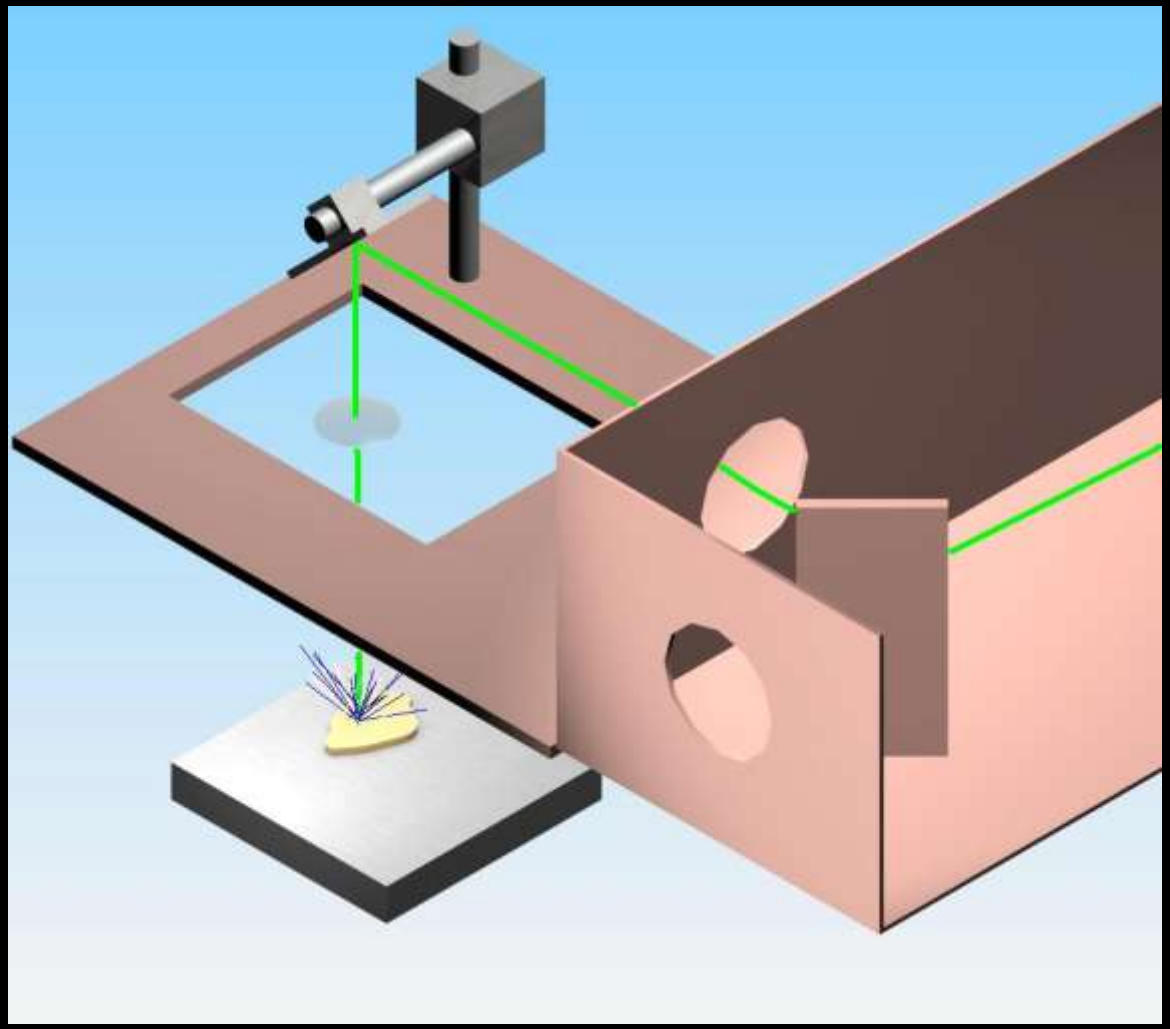

Laser Ablation Synthesis in Solutions

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- Prodution in large scale.
- Green synthesis!

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Experimental procedure

Production: first step

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- Fundamental harmonic (1064 nm) of a Nd:YAG laser operating in Q-switch and emitting 200 ns pulses with energy around 1mJ.

- Repetition rate of 1 KHz (power of 1000 mW).

Production: second step

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- Repetition rate of 100 Hz (100 mW).

- Iradiation times between 1 and 20 minutes.

Production: self-focusing

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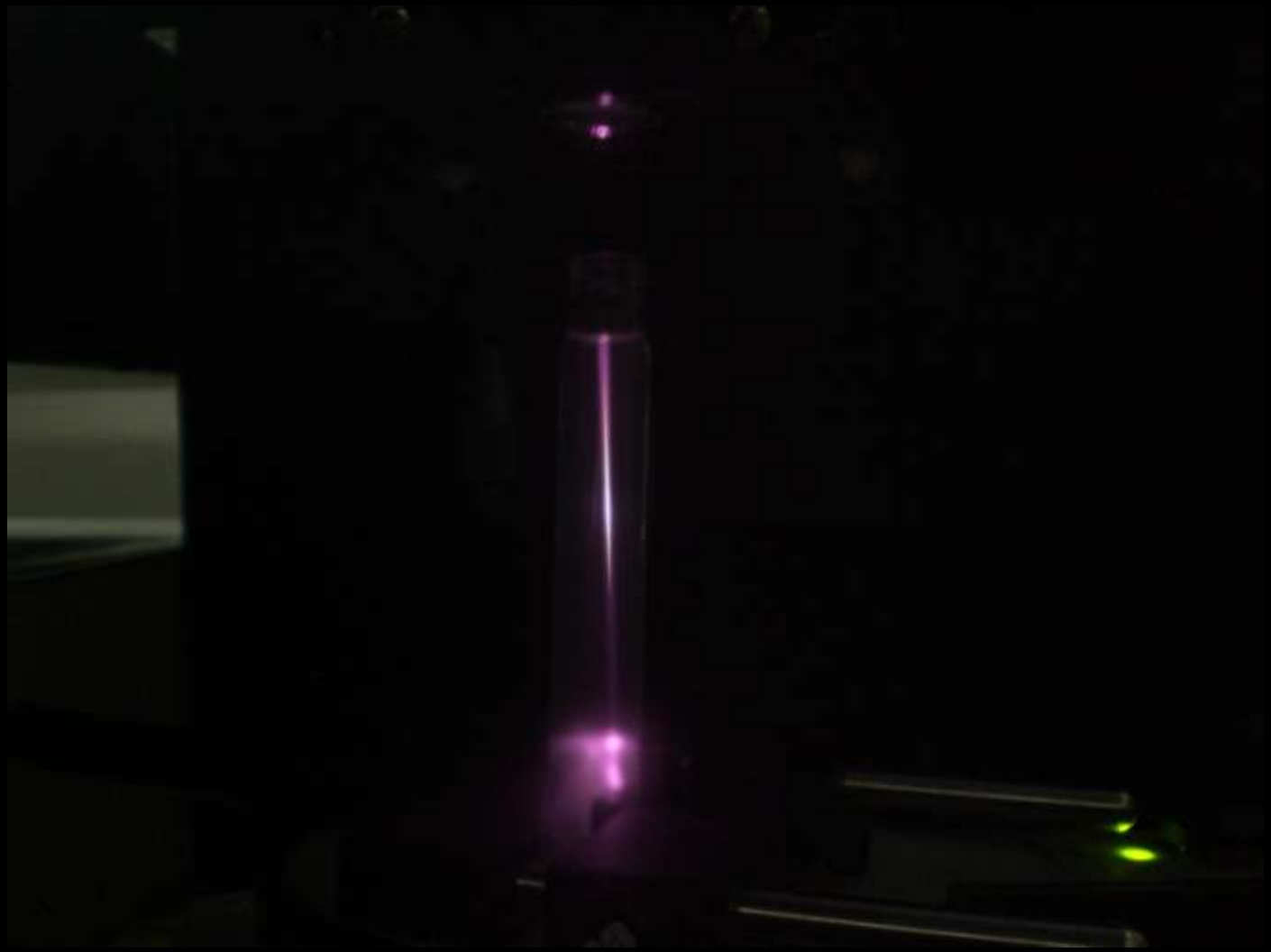

Production: self-focusing

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- Only the fundamental harmonic is used.
- Large pulses (200 ns) lead to self-focusing of the beam.
- Multiphoton absorption.
- Coulomb explosion.

Experimental results

Caracterization: UV/VIS Spectroscopy

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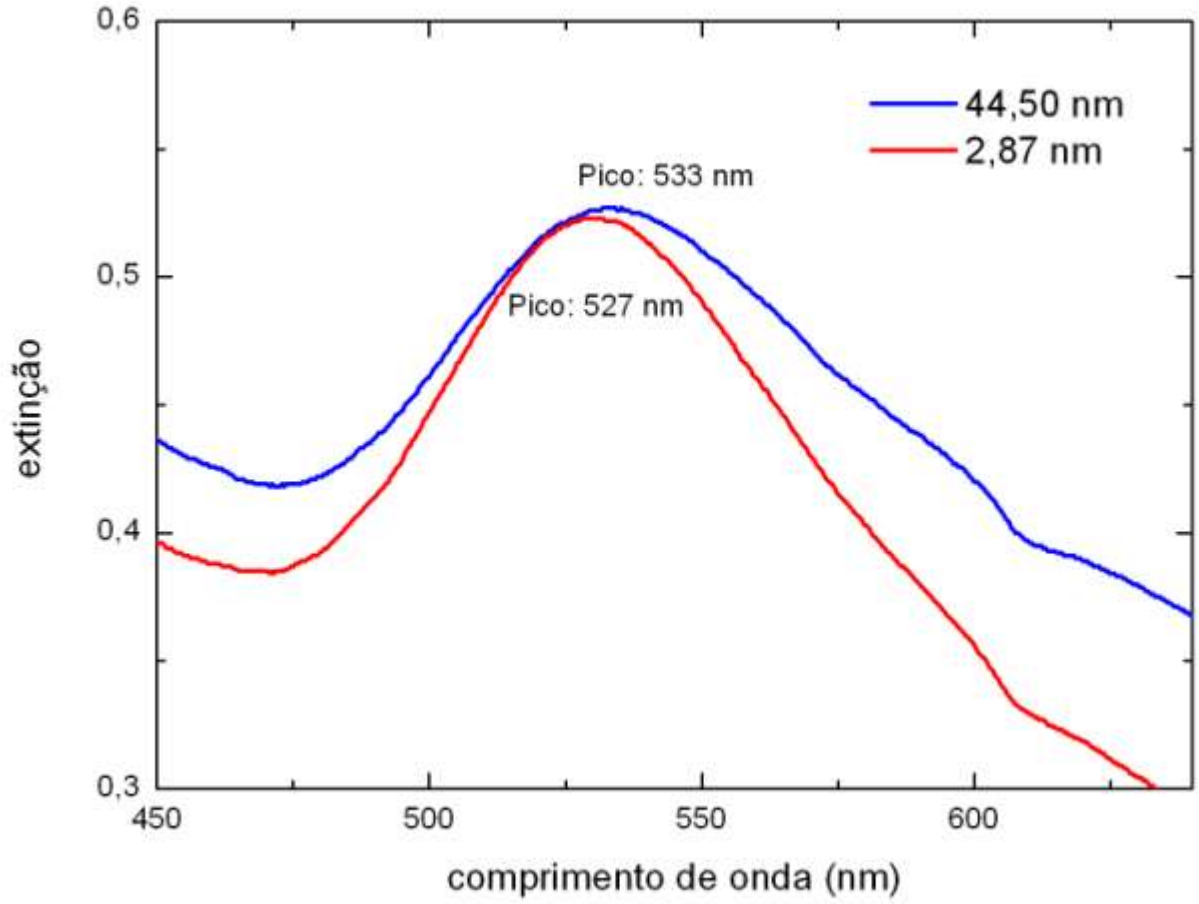
Passar para inglês



Caracterization: DLS

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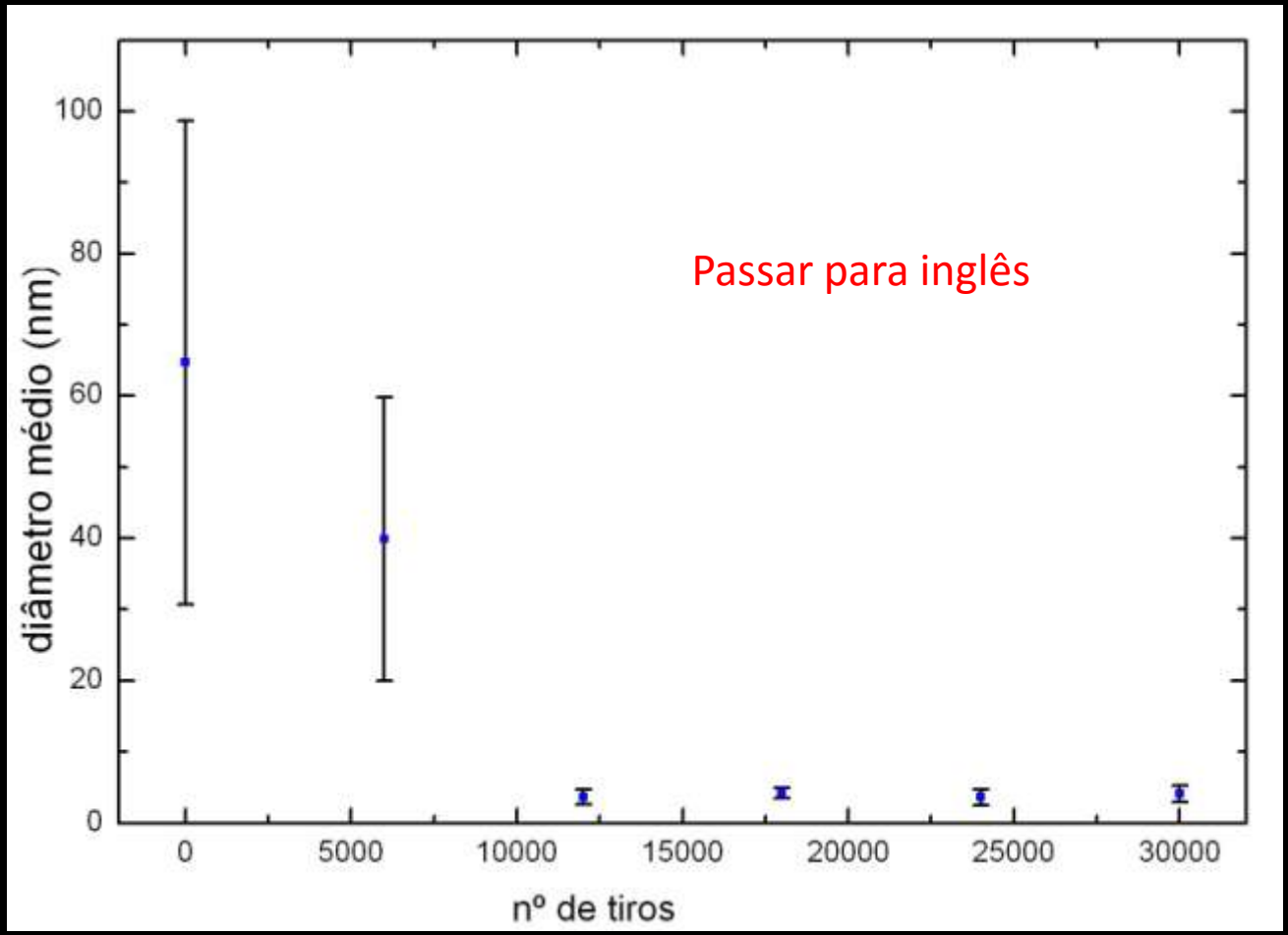

Caracterization: DLS

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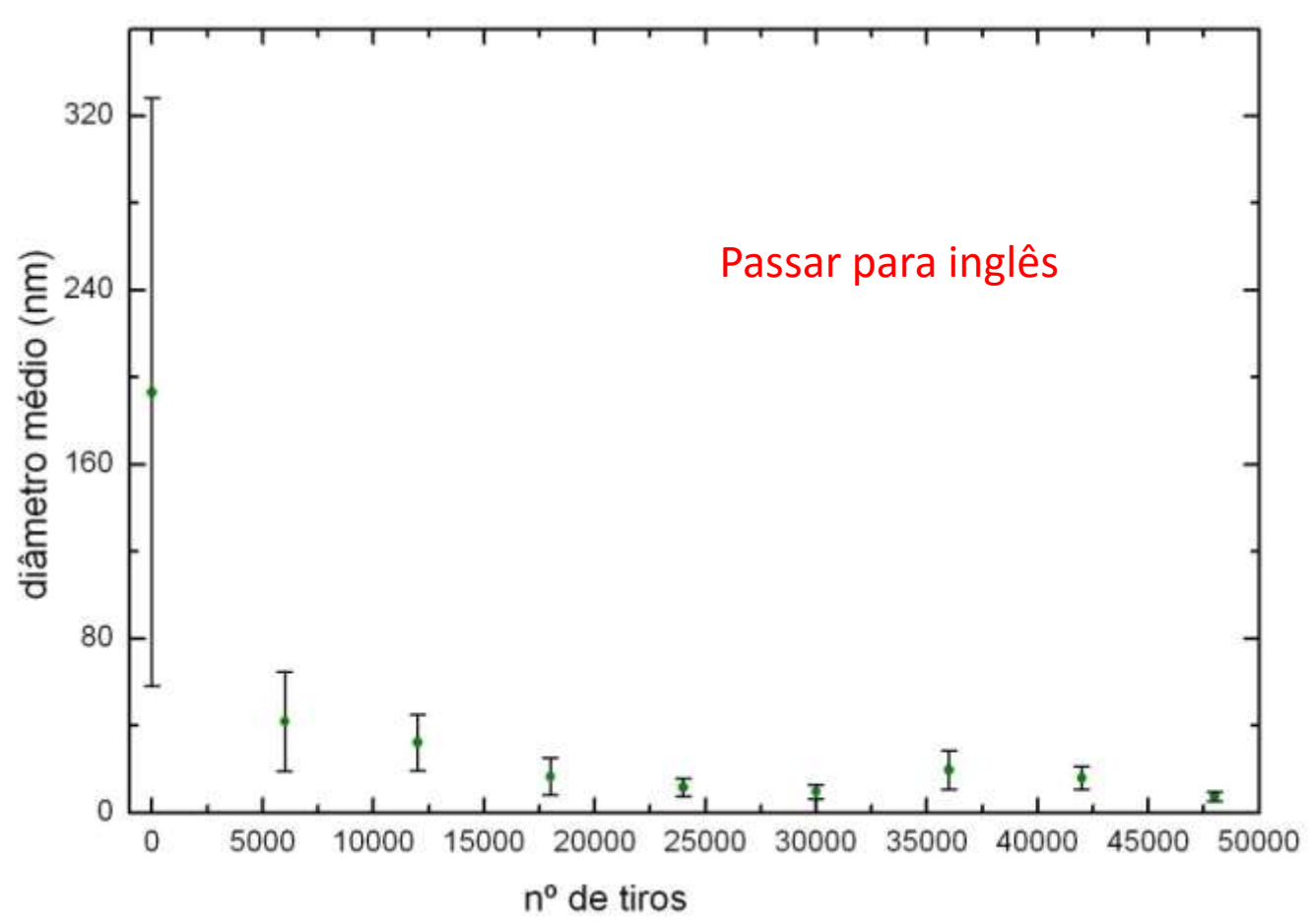

Caracterization: AFM

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Caracterization: TEM

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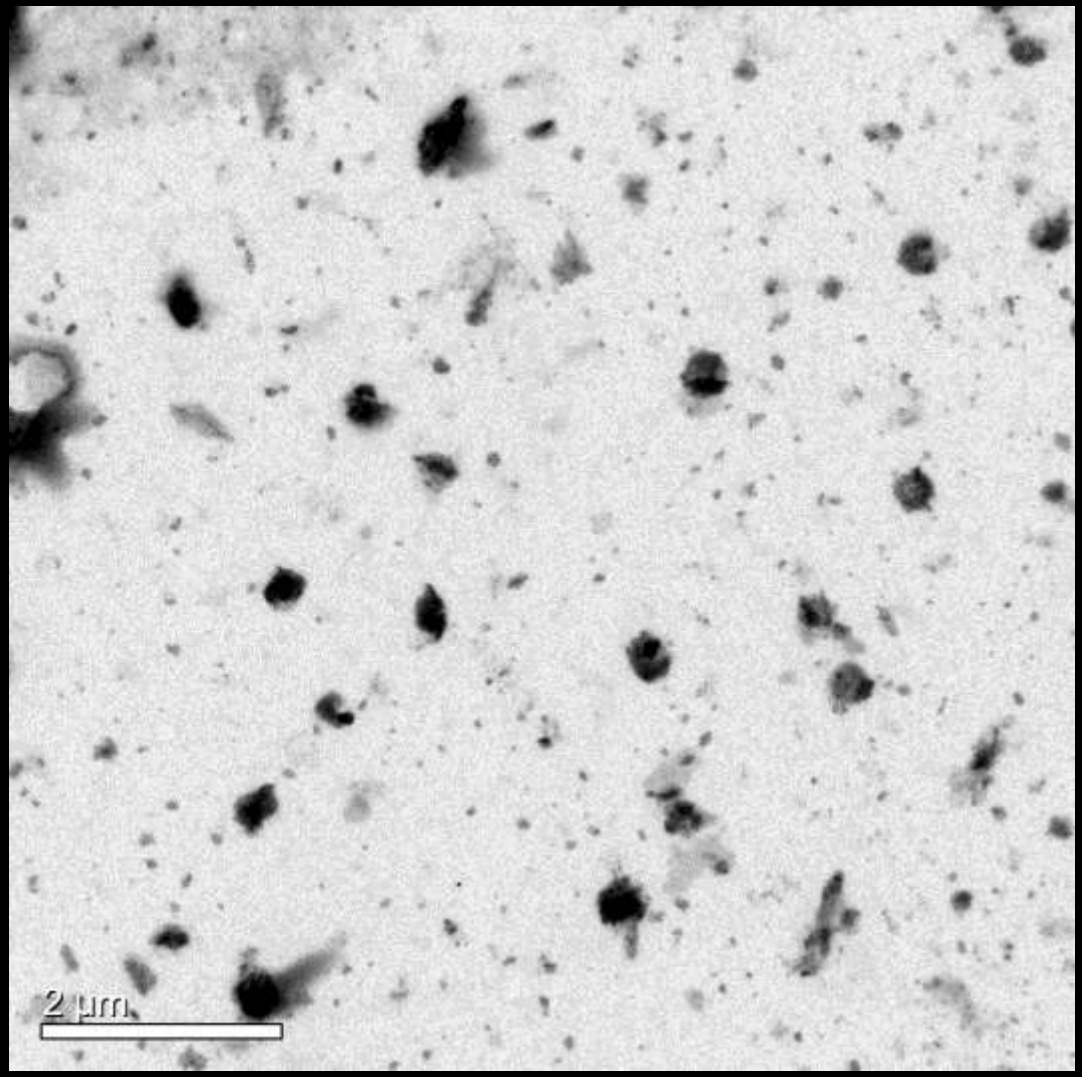

Caracterization: TEM (Histogram)

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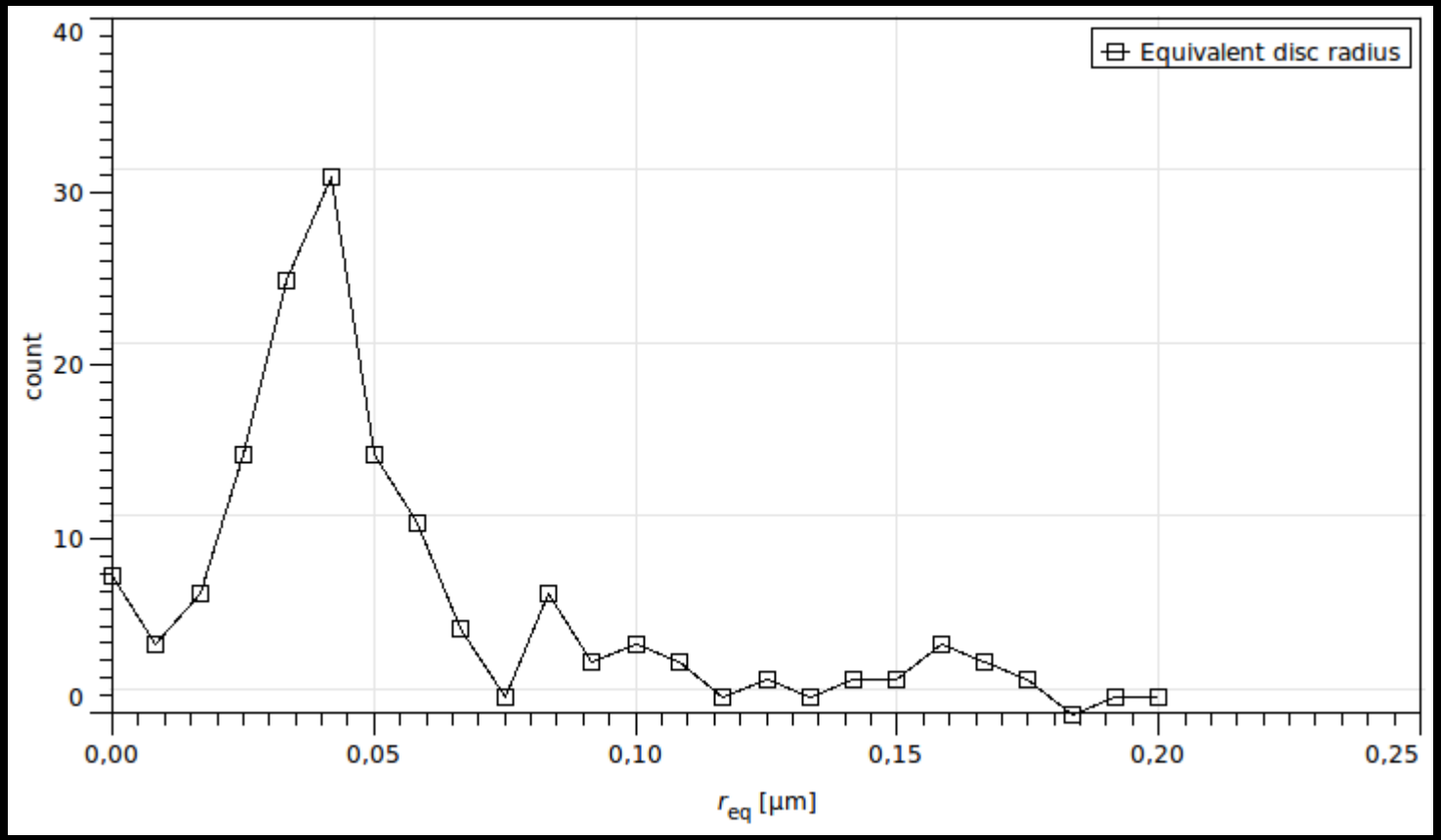

Caracterization: TEM

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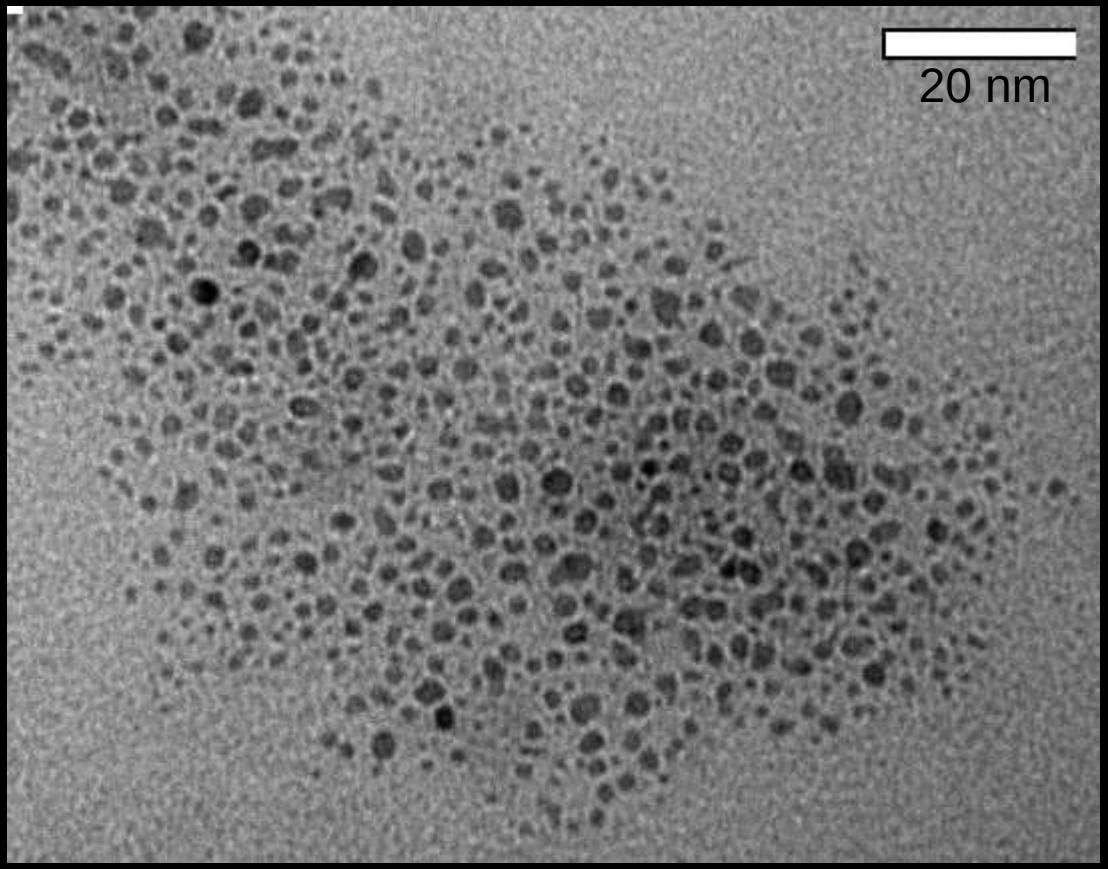

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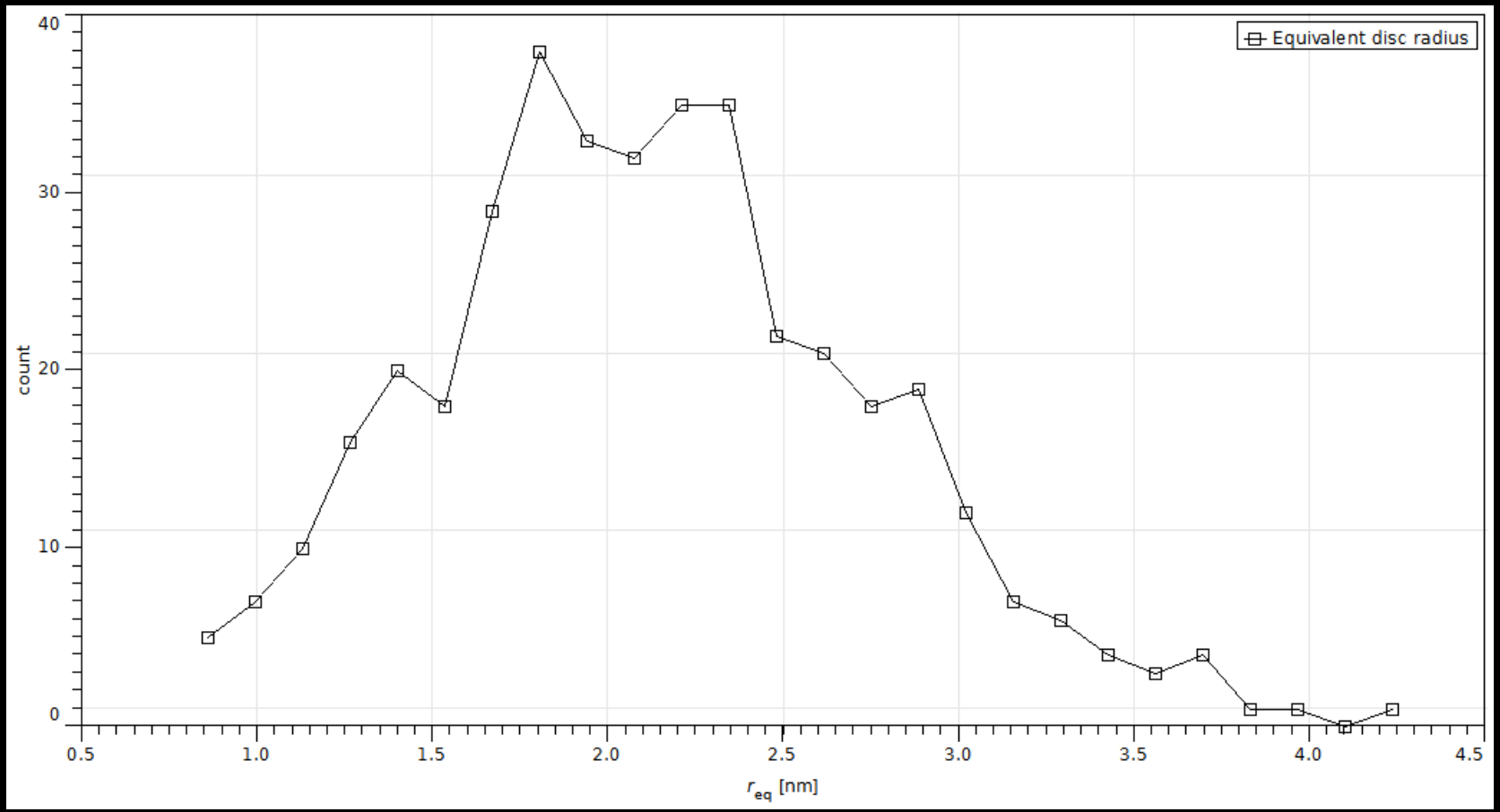

Conclusion

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- Our approach is useful for the production of small nanoparticles with low dispersion.

- TEM images confirm DLS data: nanoparticles' diameters below 10 nm.

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- TEM images confirm DLS data: nanoparticles' diameters below 10 nm.
- What makes it unique?

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- Our approach is useful for the production of small nanoparticles with low dispersion.

- TEM images confirm DLS data: nanoparticles' diameters below 10 nm.

- What makes it unique?

The use of the fundamental harmonic of a Nd:YAG laser, resulting in the self-focusing phenomenum.

References

[1] V. Amendola and M. Meneghetti, Phys. Chem. And Chem. Phys., 2009, 11, 3805-3821.

[2] Bala Krishna Juluri; Jun Huang; Lasse Jensen (2010), "Extinction, Scattering and Absorption efficiencies of multilayer nanoparticles," DOI: 10254/nanohub-r8228.2. (DOI: 10254/nanohub-r8228.2).

[3] Yuen-Yan Fong, Jason R. Gascooke, Bradley R. Visser, Gregory F. Metha, and
Mark A. Buntine, *J.* Phys. Chem. C 2010, 114, 15931–15940.