Portable Raman Acoustic Tweezers for contact-less, container-less µPlastics detection

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Pillar Environment- Spoke 4 - CNR

SAMOTHRACE 2nd Year:
Experimental Prototypes Demo Showcase

Finanziato dall'Unione europea NextGenerationEU

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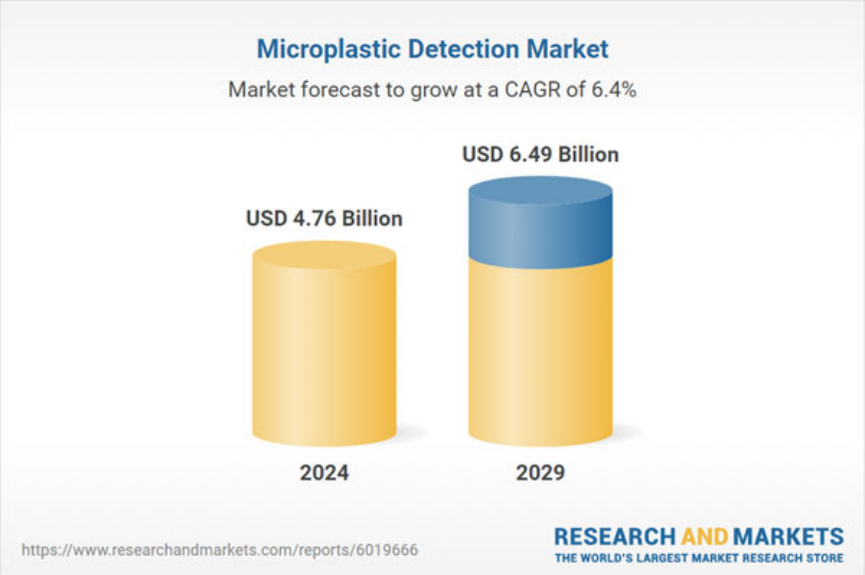
Portable Raman Acoustic Tweezers

THE PROBLEM TO BE SOLVED

- **Technological gap** in the **detection of µPlastics and nanoplastics (< 1 µm)** in aquatic ecosystems and in food.
- End users: **environmental and food safety operators** seek **fast, portable and sensitive tools** to assess the µPs presence through the food c
  especially for the nanoplastics fraction.
- **Issues with existing techniques** (Micro-FT-IR / Raman – Pyr
  - Analysis of digested organic tissues requires **lab-scale eq**
  - **Time-consuming scanning. Bottom/Lateral side not an**
  - **Contamination and background from the container** and the detection of the smallest micro- and nano- fractions.
- Market: the global **µPlastics detection market** size accounted for USD 4.80 billion in 2024, grew to USD 5.10 billion in 2025 and is estimated to hit around **USD 6.5 billion by 2029**



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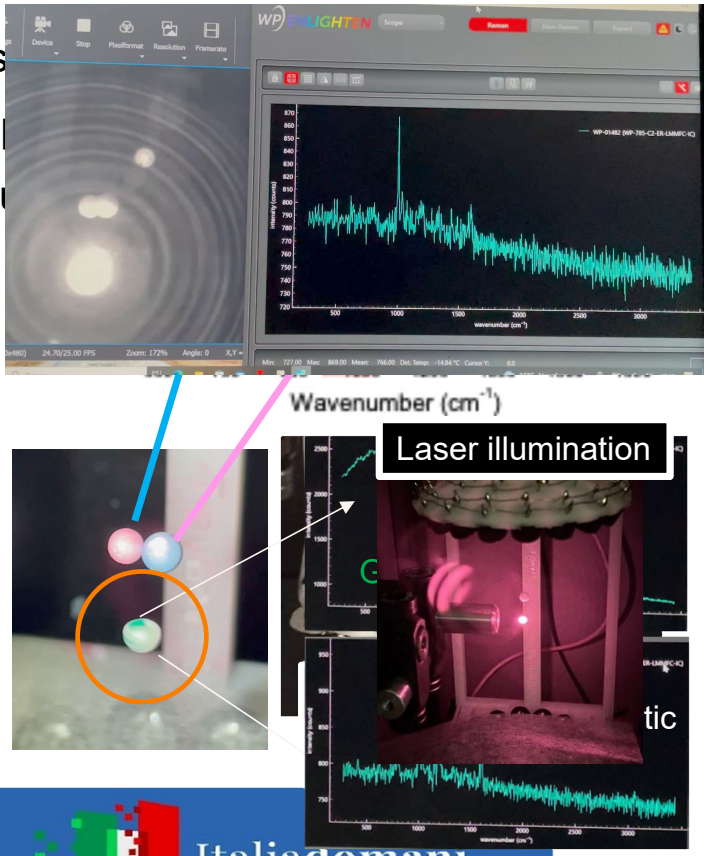
OUR SOLUTION

- **Acoustic Trapping** with low cost ultrasound transducers (as in cars sens
  - **Analyze particles levitated in air.** Solid (mm to 200 μm). Liquid dro
  - **Translate and Rotate** structures around their vertical axis without to
- **Combination with Raman** enables the **chemical analysis** of particles or molecules and nanostructures dispersed in liquids
- Unique advantages of **Portable Raman-AT**:
  - Container-less analysis → **No contamination or bkg signals**
  - Contact-less rotation → **360 · analysis** of the sample
  - **Self-concentration** of samples dispersed in liquid droplets
- **Example**: full surface analysis of a PS particle stained with fluorescent ink with no need of manual intervention



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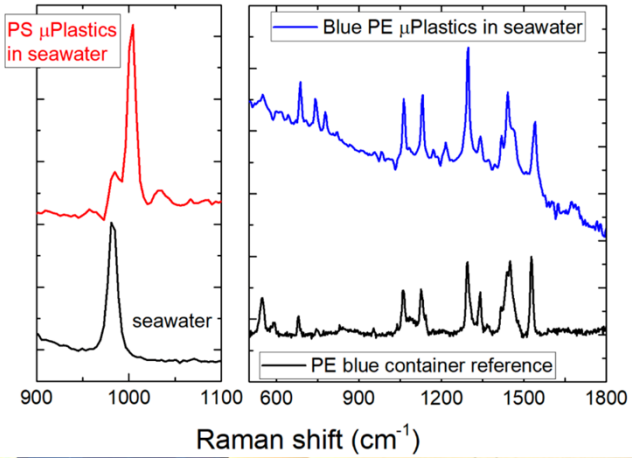
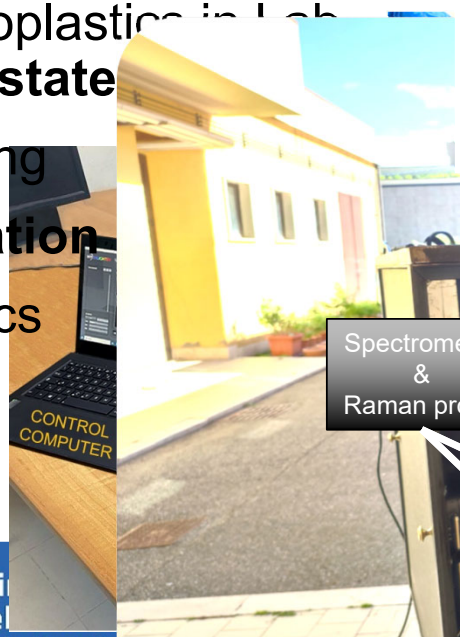
- **Starting point**: Commercial AT + Labscale spectrometer (TRL 3)
- DEVELOPMENT PLAN UNDER SAMOTHRACE
- Implementation of a **portable spectrometer and computer**
- Setup of a portable Raman-AT assembly for **out-of-lab operation**
- **Validation** on the detection of micro and nanoplastics in Lab
  Detection of **microplastics in mussels' digestate**
- Automatic loading system, Illumination, Imaging
- Optical/Acoustic enclosure for **outdoor operation**
- First validation on the detection of microplastics in liquid, outdoor (TRL ~ 5)





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NEXT STEPS UNDER SAMOTHRACE ECOSYSTEM

- **Validate the definitive system** (visit the boot) for microplastics detection in indoor/outdoor operation
- Assess the sensitivity (**particles concentration and size limits**) on the detection of micro and nanoplastics **in watery systems** and **in digested organic tissues (real systems)**
- Demonstrate the system **operating it in food and environmental science institutes** (TRL 6)
- Explore a **broader range of applications** (e.g. detection of chemical pollutants and adsorbates traces in water, textile fibres in air, …)

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Sicilian Micro and Nano Technology Research and Innovation Center

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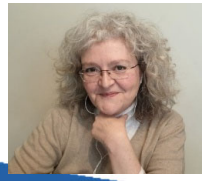
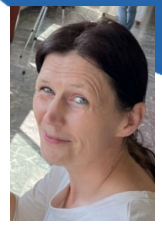
VISIT OUR DEMO AND MEET US AT BOOTH N. 54

Maria Grazia



Nino

Silva



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