ACS National Meeting, paper id 4286177, "Creation of particles from plastic containers" presented at the Fall (Washington, D.C.) meeting on 19 August 2025 in Convention Center 140B at 8:05AM

videos shown during the presentation are available at markjonesphd.com/acs-dc2025

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Creation of Particles from Plastic Containers

Mark Jones
Creative Director
MJPhD, LLC

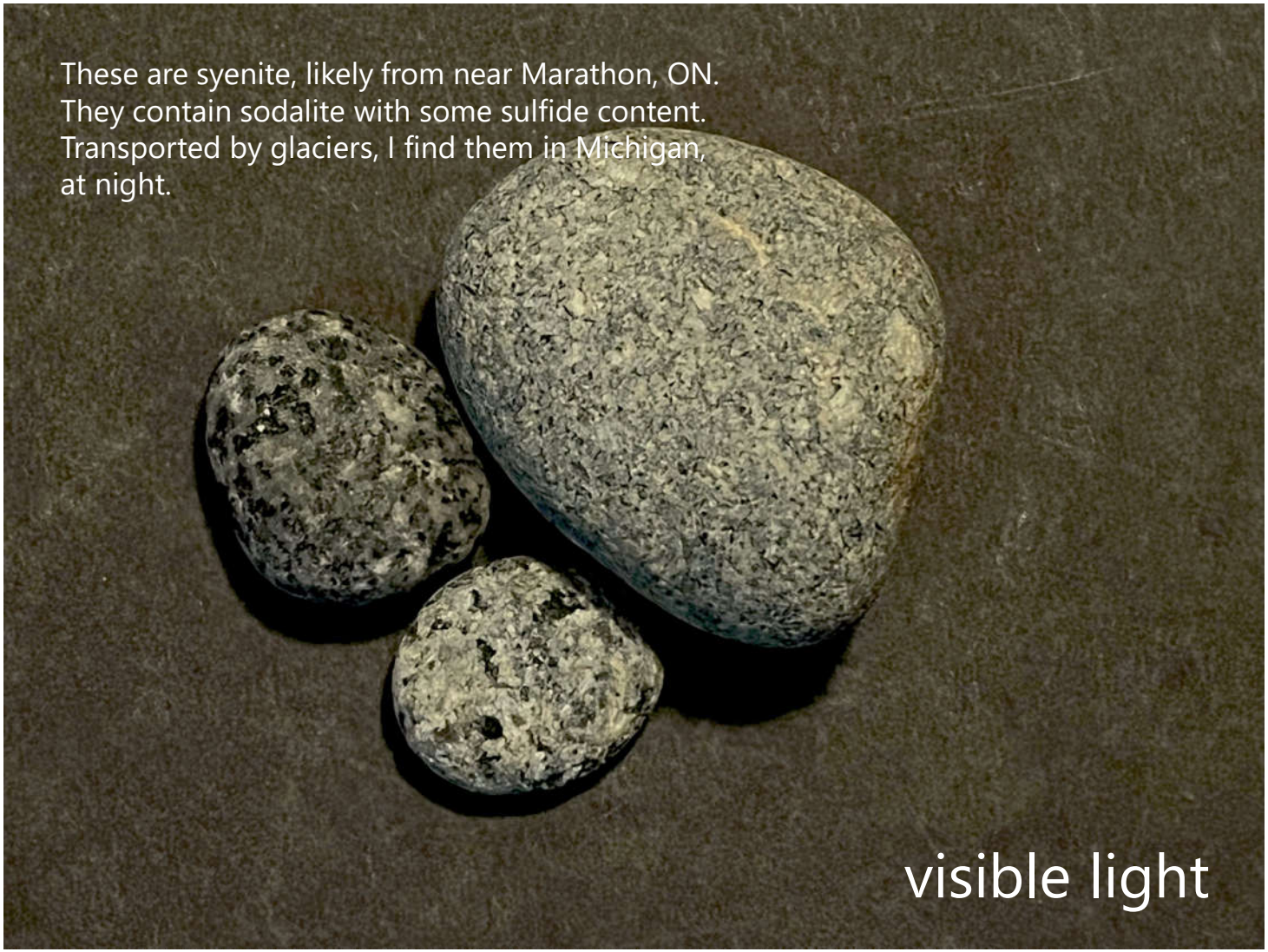
Dale Lecaptain
Professor
Central Michigan University

19 August 2025

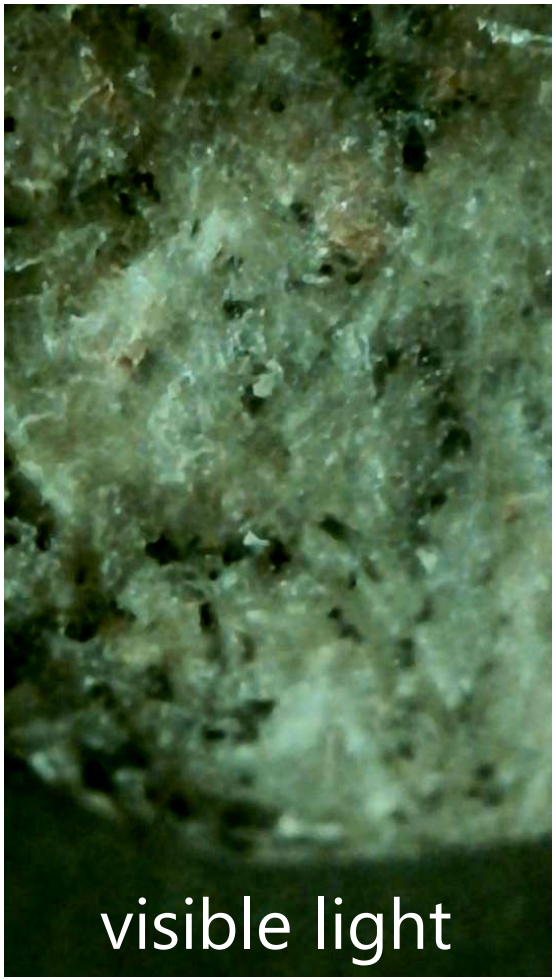
Plastic containers used for beverages shed plastic particles when physically stressed during shipment and use.

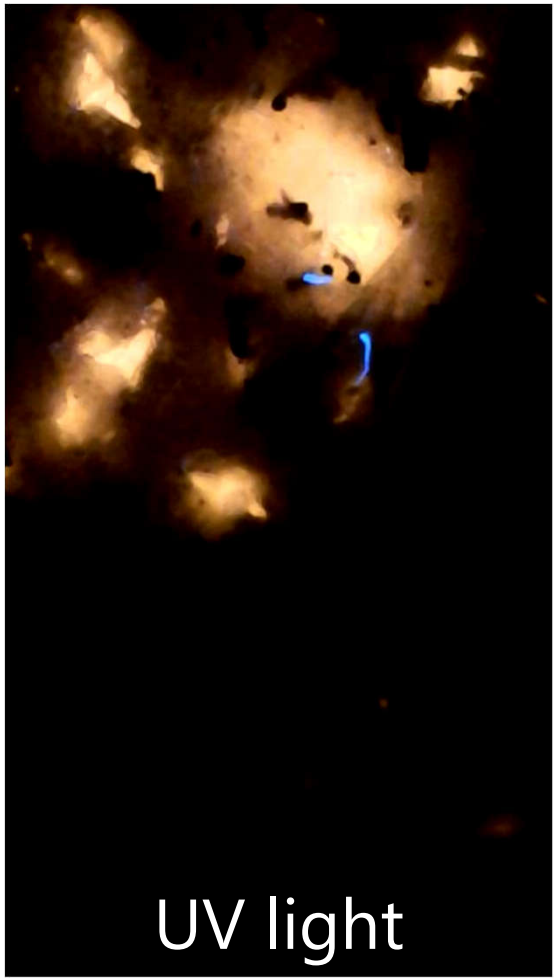
Particles are produced in a range of polymers and container types including single-use and reusable containers, including those for health.

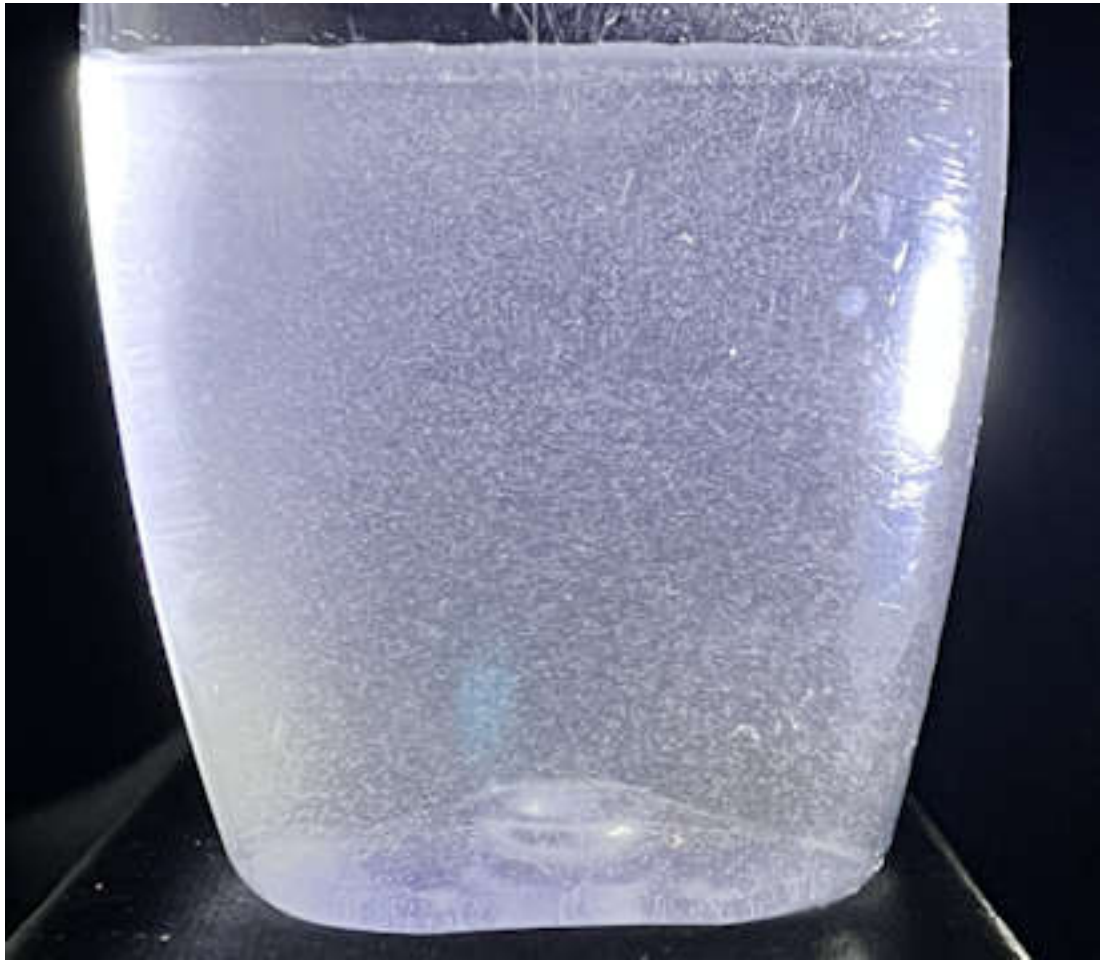
Lipophilic solids and liquids remove micro- and nanoplastic particles from water.


These are syenite, likely from near Marathon, ON.
They contain sodalite with some sulfide content.
Transported by glaciers, I find them in Michigan,
at night.
visible light


Yooperlites
UV light
(365 nm filtered)


visible light


UV light

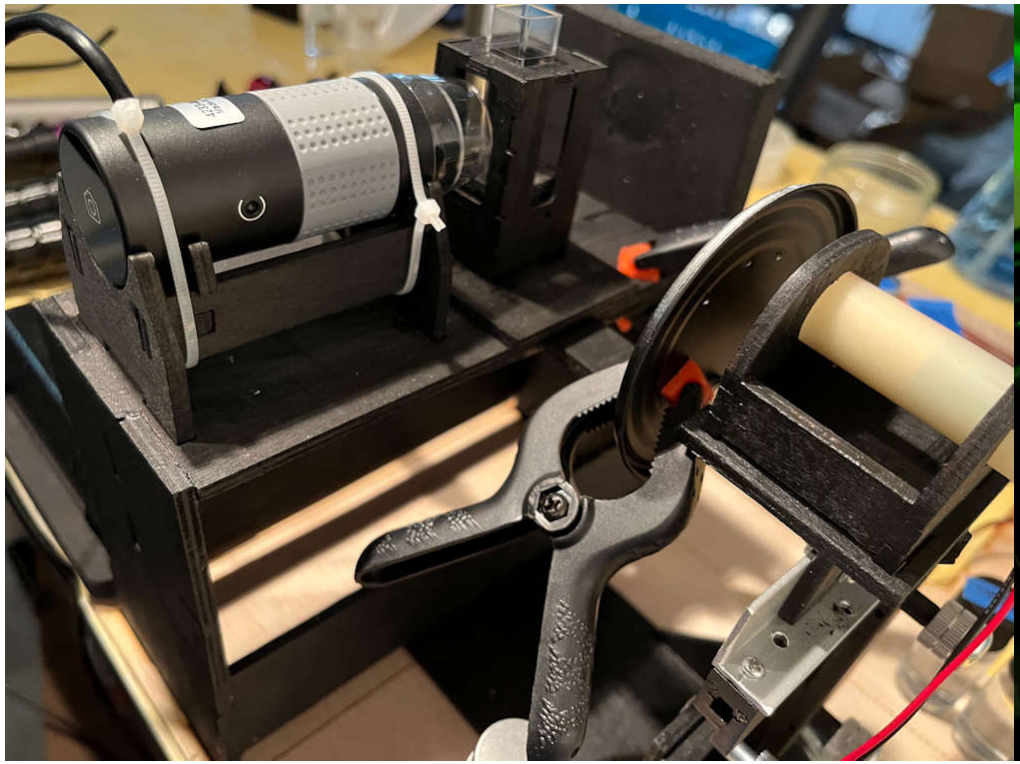


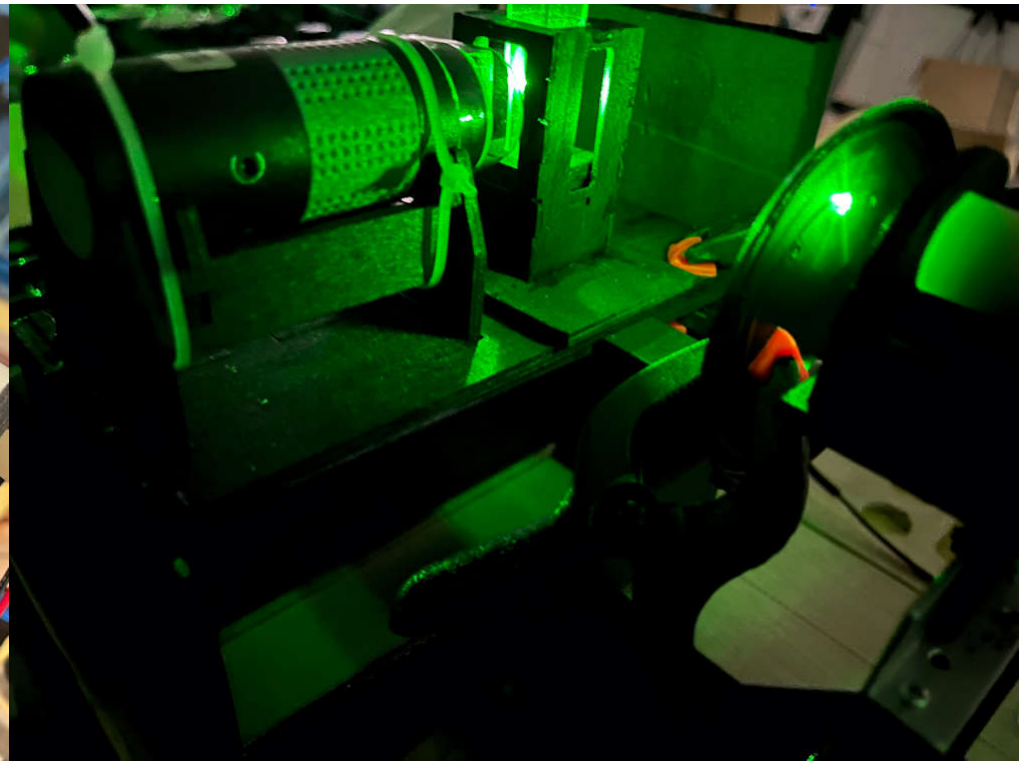
CAMERAS AND MICROSCOPES

requires hardware that does not automatically adjust exposure

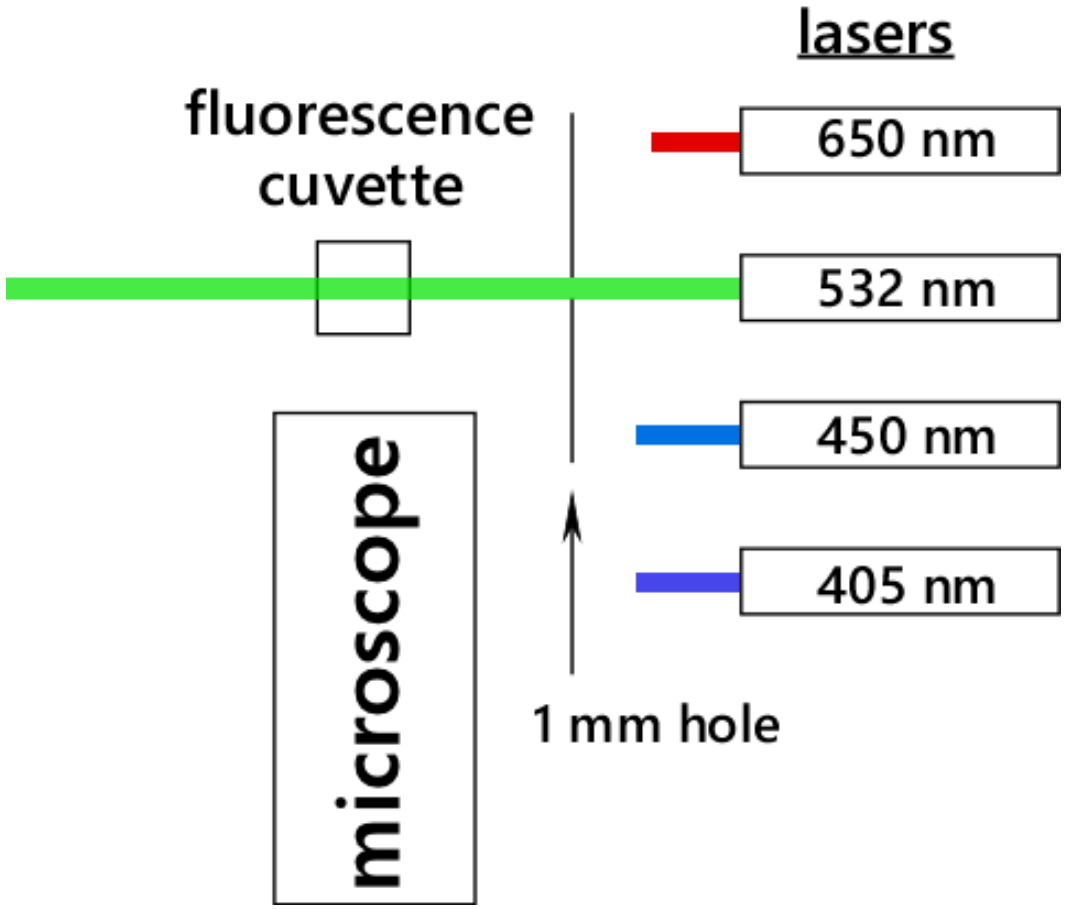
cameras with Sony low-light sensors (2.1 and 4 megapixel [IMX 323 and IMX586 CMOS sensor])

Rayleigh Scattering



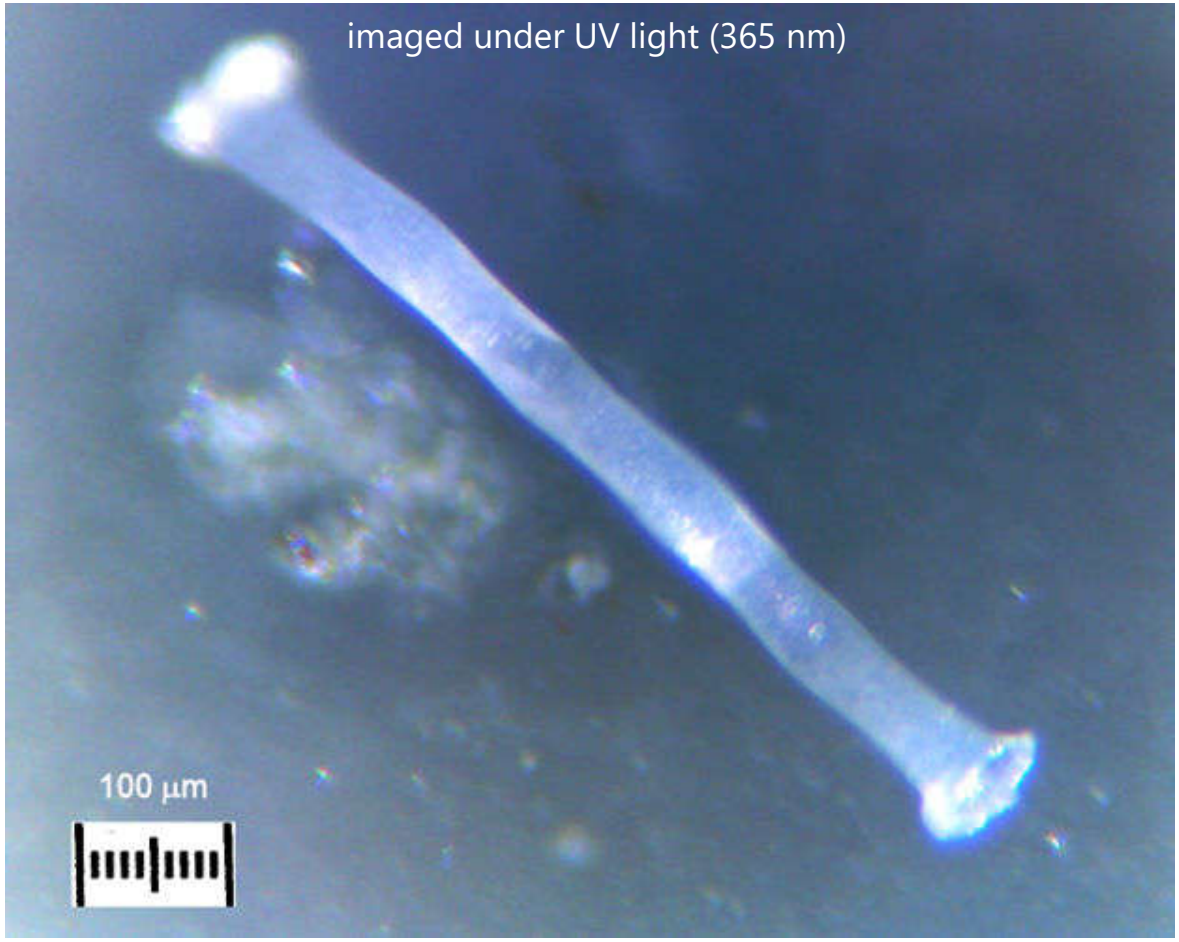


RAYLEIGH SCATTERING



Ye, Yan, and David YH Pui. "Detection of nanoparticles suspended in a light scattering medium." Scientific reports 11, no. 1 (2021): 20268.

From Commercial Bottled Water



Commercial Bottled Water

19 March 2025

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Observations and Hypothesis

- Observations:
  - it is impossible to find water free of particles
  - water with the same lot numbers and in the same cases/packages contain different amounts of plastic particles
  - bottles on the outside of cases/packages can, but don't always, contain more particles than those in the center of the case/package
  - there are particles produced from processing equipment present

- Hypothesis: impacts and flexing of polymer containers creates microplastic particles

WATER BOTTLE ABUSE

- half-filled commercial water bottle
- drop from approx. 2 feet 1500, 3000 or 4500 times
- use 66 cm diameter, cylindrical, baffled tumbler operating at 50 revolutions per minute
- half-filled to allow more distortion, to overcome centripetal force and to limit equipment damage

Water Bottle Abuse

- set on air dry (no heat)
- operate for 30 minutes for one or two cycles

Abused Water Bottles

6 November 2024

60 Minutes of Abuse

PureAqua Bottle
UV light
November 2024

Abuse Options

Abuse Options

- moved to 50 ml per container
- either never completely empty bottle or minimum triple rinse
- 50 mL filled and saved as blank

PET Water Bottles

August 2025

Tested Lots of Containers

- washed ≥ 3 times with last wash retained for reference using the most particle free water on-hand
- abuse and record time
- take micrograph of visible partilces
- look at before and after Rayleigh scattering to assess nanoparticles

Starting Water

August 2025

PET Water Bottle

August 2025

HDPE Jug

August 2025

Air Hammer-
5 min

HDPE

August 2025

Tea Bottle

August 2025

CARTONS


BOXED WATER IS BETTER.
PURIFIED WATER
33.8 FL OZ 1.05 QT 1 LITER
100% naturally alkaline spring water
flow
alkaline spring water
JUST WATER

Carton

August 2025

Reuseable Water Bottle

August 2025

IV Bag

August 2025

Contact Solution

August 2025

OBSERVATIONS

- Observations:
  - it is impossible to find water free of particles
  - water with the same lot numbers and in the same cases/packages contain different amounts of plastic particles
  - bottles on the outside of cases/packages can, but don't always contain more particles than those in the center of the case/package
  - there are particles produced from processing equipment present
  - impacts and flexing of polymer containers create microplastic particles, some surprisingly big

Operating Hypothesis (Proving Difficult to Prove)

$$C\left[\frac{\text{particles}}{V}\right] = C_0 + \frac{\alpha I}{V}$$

factor

impacts

volume

Removal Options

- Previous work (described at the 2025 ACS National Meeting in San Diego) showed that PET, PE, PP, tire and more particles are very lipophilic
- Capture was shown in oil and on lipophilic solids


Captured
Particles
13 March 2025

MCT Oil in PET

August 2025

SUMMARY

- lipophilic solids capture plastic particles
- allow easy imaging of particles sampled
- hard if not impossible to get to zero but substantial reductions are possible

Plastic containers used for beverages shed plastic particles when physically stressed during shipment and use.

Particles are produced in a range of polymers and container types including single-use and reusable containers, including those for health.

Lipophilic solids and liquids remove micro- and nanoplastic particles from water.


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