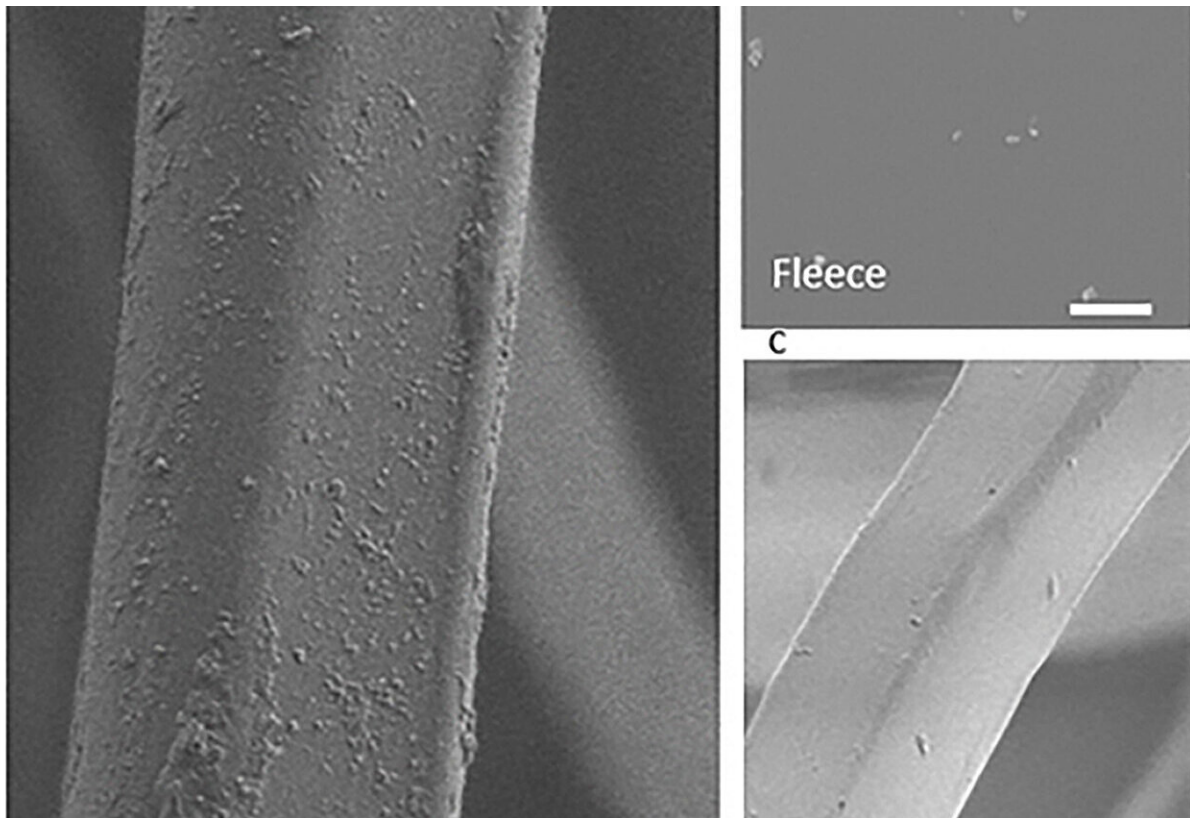


When nanoplastics are not what they seem: Release of oligomers from polyester textiles

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The nanoparticles on the surface of the fleece fiber are visible under a scanning electron microscope (a). The particles detach during washing (b), so that after four washes there are hardly any left. Credit: Empa

Plastic household items and clothing made of synthetic fibers release microplastics, particles less than five millimeters in size that can enter

the environment unnoticed. A small proportion of these particles are so small that they are measured in nanometers. Such nanoplastics are the subject of intensive research, as nanoplastic particles can be absorbed into the human body due to their small size—but, as of today, little is known about their potential toxicity.

Empa researchers from Bernd Nowack's group in the Technology and Society laboratory have now joined forces with colleagues from China to take a closer look at nanoparticles released from textiles. Tong Yang, the first author of the study, carried out the investigations during his doctorate at Empa. In earlier studies, Empa researchers were already able to demonstrate that both micro- and nanoplastics are released when polyester is washed.

A detailed examination of the released nanoparticles has now shown that not everything that appears to be nanoplastic at first glance is actually nanoplastic.

To a considerable extent, the released particles were, in fact, not nanoplastics, but clumps of so-called oligomers, i.e., small to medium-sized molecules that represent an intermediate stage between the long-chained polymers and their individual building blocks, the monomers. These molecules are even smaller than [nanoplastic](#) particles, and hardly anything is known about their toxicity either. The researchers [published](#) their findings in the journal *Nature Water*.

For the study, the researchers examined twelve different polyester fabrics, including microfiber, satin, and jersey. The fabric samples were washed up to four times, and the nanoparticles released in the process were analyzed and characterized. Not an easy task, says Bernd Nowack. "Plastic, especially nanoplastics, is everywhere, including on our devices and utensils," says the scientist. "When measuring nanoplastics, we have to take this 'background noise' into account."

Large proportion of soluble particles

The researchers used an ethanol bath to distinguish nanoplastics from clumps of oligomers. Plastic pieces, no matter how small, do not dissolve in ethanol, but aggregations of oligomers do. The result: Around a third to almost 90% of the nanoparticles released during washing could be dissolved in ethanol. "This allowed us to show that not everything that looks like nano plastics at first glance is, in fact, nanoplastics," says Nowack.

It is not yet clear whether the release of so-called nanoparticulate oligomers during the washing of textiles has negative effects on humans and the environment. "With other plastics, studies have already shown that nanoparticulate oligomers are more toxic than nanoplastics," says Nowack. "This is an indication that this should be investigated more closely."

However, the researchers were able to establish that the nature of the textile and the cutting method—scissors or laser—have no major influence on the quantity of particles released.

The mechanism of release has not been clarified yet either—neither for nano plastics nor for the oligomer particles. The good news is that the amount of particles released decreases significantly with repeated washes. It is conceivable that the oligomer particles are created during the manufacturing of the [textile](#) or split off from the fibers through chemical processes during storage. Further studies are also required in this area.

Nowack and his team are focusing on larger particles for the time being. In their next project, they want to investigate which fibers are released during washing of textiles made from renewable raw materials and whether these could harm the environment and health. "Semi-synthetic

textiles such as viscose or lyocell are being touted as a replacement for polyester," says Nowack. "But we don't yet know whether they are really better when it comes to releasing fibers."

More information: Tong Yang et al, Oligomers are a major fraction of the released submicrometre particles released during washing of polyester textiles, *Nature Water* (2024). [DOI: 10.1038/s44221-023-00191-5](https://doi.org/10.1038/s44221-023-00191-5)

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