# Research improves dry lubricant used in machinery and biomedical devices

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Nearly everyone is familiar with the polytetrafluoroethylene (PTFE), otherwise known as Teflon, the brand name used by the chemical company DuPont. Famous for being "non-sticky" and water repellent, PTFE is a dry lubricant used on machine components everywhere, from kitchen tools and engine cylinders to space and biomedical applications.

Recently, engineering researchers at the University of Arkansas found a way to make the polymer even less adhesive. They treated thin films of PTFD with silica nanoparticles and found that the lubricating material significantly reduced wear of the polymer while maintaining a low level of friction. The researchers' work will enable machinery to last longer and operate more efficiently.

"Polytetrafluoroethylene is a big, scary word," said. Min Zou, an associate professor of mechanical engineering. "What we're talking about here is a material layer or coating – a film – that essentially does not stick and is hydrophobic, meaning it repels water."

Solid lubricants such as PTFE are appealing because they perform well in high temperatures, have low maintenance costs and are clean compared to liquids. They are essential in an industrial setting, where the surfaces of various mechanical parts are constantly coming into contact with each other.

PTFE compares favorably to other solid lubricant materials because of its self-lubricating properties, its ability to produce low friction and its

resistance to high temperatures and chemicals. It has been used as a lubrication polymer for many years, and recently scientists and engineers have attempted to improve the material by incorporating nanoparticle "fillers" that reduce wear on the material and thus extend its life. However, high concentrations of these nano-fillers have created a problem: while reducing wear, they have also increased the material's ability to create friction.

"A great obstacle in micro- and nanocomposite films has been the inability to find a filler material that provides good wear resistance as well as a low coefficient of friction," Zou said.

But that's exactly what Zou found in silica. After integrating the nanoparticle material into PTFE in two different concentrations, she and her graduate student Samuel Beckford applied the thin films to a stainless steel substrate. They subjected the films to abrasive tests to measure the degree of friction and wear resistance. For comparison, they did the same experiments on a pure PTFE film and on bare stainless steel. Andrew Wang with Ocean NanoTech, a local technology firm, helped with size characterization of the nanoparticles.

"Micrographs revealed that the composite films with higher concentration of silica had much narrower wear tracks after the samples were subjected to rubbing tests," Zou said.

The study was published in *Tribology Transactions*, a journal of the Society of Tribologists and Lubrication Engineers (STLE), and received the STLE Al Sonntag Award for the best paper published on solid lubricants.

Provided by University of Arkansas