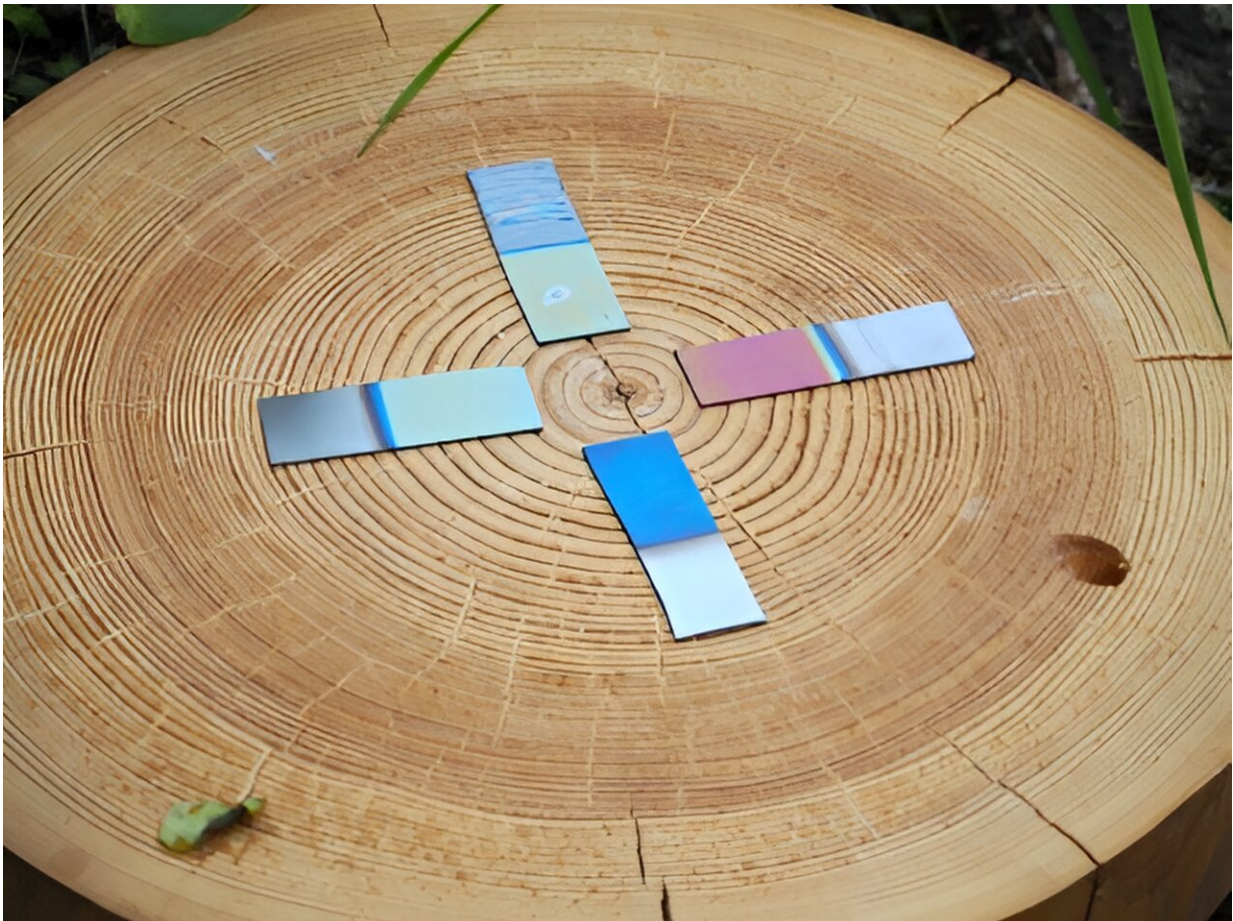


Coatings made from a wood by-product can keep our glasses and windshields clear

September 26 2023



Films made of lignin nanoparticles can have structural coloration or be used as transparent anti-fog coatings. Credit: Alexander Henn / Aalto University

Researchers have developed a way to turn a waste material from wood into a bio-based transparent film that can be used for anti-fogging or anti-reflective coatings on glasses or vehicle windows. In addition to offering an alternative to the toxic synthetic materials currently used, this approach transforms a waste product into a valuable carbon sink.

The study was [published](#) in *Chemical Engineering Journal* and was carried out as part of FinnCERES, the Academy of Finland's flagship center for materials bioeconomy research.

Lignin is an abundant [waste product](#) in paper and pulp production that is very difficult to process, so it's usually burned to produce heat. Creating [lignin](#) nanoparticles to use for anti-fogging coatings isn't a new idea, but scientists haven't yet been able to turn them into transparent films.

"Optical coatings need to be transparent, but so far, even rather thin lignin particle films have been visible. We knew that [small particles](#) appear less turbid, so I wanted to see if I could make invisible particle films by pushing the [particle size](#) to a minimum," says doctoral researcher Alexander Henn, the study's lead author.

The team used acetylated lignin and developed an improved way to esterify it in a reaction that takes just a few minutes and happens at the relatively low temperature of 60°C.

"The lignin particles I made from the acetylated lignin had rather surprising properties, which made the rest of this study very interesting. The possibility to make photonic films, for example, came as a total surprise," says Henn.

In addition to anti-fogging and anti-reflective coatings, the new approach can also make colored films from lignin nanoparticles. By controlling the thickness of the coating and using multi-layer films, the team created

materials with different structural colors.

"Sahar Babaeipour's efforts were key to controlling the particles' photonic properties," says Henn, adding that researchers Paula Nousiainen and Kristoffer Meinander brought expertise in lignin chemistry and photonic phenomena, respectively, helping the team make sense of their results and use them effectively.

According to the team's feasibility study, the ease of the reaction and its high yield mean that it could profitably be scaled up to industrial levels. "Lignin-based products could be commercially valuable and simultaneously act as carbon sinks, helping relieve the current fossil fuel-dependence and reduce [carbon dioxide emissions](#)," says Professor Monika Österberg. "High value-added applications like this are important to drive lignin valorization and move us away from using lignin only as a fuel."

Henn notes the study benefited from having perspectives that took it beyond the lab bench. "Teamwork was an important part of making this study impactful. We were able to include the techno-economic analysis with the help of Professor Pekka Oinas and doctoral researcher Susanna Forsell," he says.

More information: Karl Alexander Henn et al, Transparent lignin nanoparticles for superhydrophilic antifogging coatings and photonic films, *Chemical Engineering Journal* (2023). [DOI: 10.1016/j.cej.2023.145965](#)

Provided by Aalto University

Citation: Coatings made from a wood by-product can keep our glasses and windshields clear

(2023, September 26) retrieved 28 April 2024 from <https://phys.org/news/2023-09-coatings-wood-by-product-glasses-windshields.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.