

# Breakthrough in lignin research—spherical particles multiply enzyme efficiency

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Biocatalysts (pictured at the bottom of the vial), supported by spherical lignin particles and embedded in natural polymer matrix, open new avenues to green synthesis reactions in the presence of water. Credit: Valeria Azovskaya

Researchers at Aalto University and York University have succeeded in creating a water-repellent composite structure out of lignin particles, in which the enzymes or biocatalysts can be separated from surrounding water. The breakthrough was accomplished when the researchers

discovered that, by regulating the surface charge of single lignin particles, enzymes can be made to adhere to the surface of particles. As material supporting the structure, they utilised a natural polymer isolated from seaweed.

The starting point for the research was the need to utilise [lignin](#), a pulp industry by-product, for new, large-scale purposes. The researchers were surprised to discover that, when introduced, the lignin particles multiplied enzyme efficiency and enabled enzyme recycling in a synthetic reaction that would not otherwise occur in water.

"The beauty of this method lies in its simplicity and scalability. We are already able to manufacture lignin [particles](#) in batches of several kilogrammes. Of course, we hope that this will become a sustainable option for the enzyme industry to replace fossil materials in technical applications," says Postdoctoral Researcher Mika Sipponen.

Lignin not only multiplies enzyme efficiency, it also shows good results in comparison to those substances currently on the market, created from unsustainable sources. "The commercial [enzyme](#) we use as reference is attached to the surface of synthetic acrylic resin produced from fossil raw materials. In comparison, this new biocatalyst was at best twice as active," Sipponen adds.

In the reaction, alcohol and organic acid created in biofuel production produced a water-insoluble ester with a pineapple scent. The process opens up new possibilities for the production of bio-based polyesters, as well.

"We are pleased that the years of investing in the lignin particle research are beginning to produce significant results. We envision several possible uses for [spherical particles](#) in green chemistry processes and the development of new [materials](#)," says research leader Professor Monika

Österberg.

The research was funded by the Academy of Finland.

The article "Spatially confined lignin nanospheres for biocatalytic ester synthesis in aqueous media" was published in *Nature Communications*.

**More information:** Mika Henrikki Sipponen et al. Spatially confined lignin nanospheres for biocatalytic ester synthesis in aqueous media, *Nature Communications* (2018). DOI: [10.1038/s41467-018-04715-6](https://doi.org/10.1038/s41467-018-04715-6)

Provided by Aalto University

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