

Danish chemist aims to bring supermolecules to the world

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With applications spanning from non-shrink dental fillings to DNA-drugs the so-called dendrimers are a near magical material. Now a chemist from the University of Copenhagen has vowed to make the weird molecules famous.

When a molecule's structure resembles that of two tree crowns growing into one another, it really ought to be organic. But if that molecule happens to be synthetic, well, that is something exciting! [Dendrimers](#) are types of [molecules](#) fitting this bill. They are synthetic, but natural in appearance. They have incredible properties and now, a Danish chemist has written a book to broaden awareness of these remarkable synthetic macromolecules.

Jørn Bolstad Christensen is an associate professor at the Department of Chemistry at the University of Copenhagen. His just released book is entitled "Dendrimers, Dendrons and Dendritic Polymers: Discovery, Applications and the Future", and is published by Cambridge University Press. The book is co-authored by [chemist](#) Ulrik Boas and one of chemistry's international superstars, Donald Tomalia. Tomalia is world famous as one of the first to create examples of the magical [macromolecules](#), he came to Boas and Bolstad because they had established their own reputations for being able to couple chemistry with a highly interesting [biological research](#) angle.

"We had written a book about Dendrimers which reached a large audience and Tomalia wanted to do the same. We could help with

writing about the biological aspects so that chemists could understand it and about the chemistry in a way that was accessible for biologists," explains Bolstad.

Mimicing the properties of hair, pearl and bone

The hyper-branched tree-like molecules are as large and complex as nature's very own [chemical substances](#). They can be used to mimic the natural properties of materials such as hair, wood, mother of pearl and bone. But they are entirely synthetic. This makes them exceptionally interesting for a range of industrial and scientific applications because they serve as bridge builders between the biological and chemical, explains Bolstad. Their properties make them ideal for when you want to examine how biological/chemical systems, such as proteins, behave. Among other abilities, chemists are able to build protein-like substances in which one is able to change ONE property at a time, thus furthering much greater precision within biomedical research.

"In contrast with conventional biotechnological methods, with dendrimer chemistry we are no longer bound by nature's own limits. We can actually design molecules to precisely suit our needs," states Bolstad.

Weird molecules appliccable in gene therapy

The ability to fine tune is particularly useful in the development of new approaches to combat disease via gene therapy. In theory, genetic material such as siRNA could be used to combat hereditary diseases. However, bodily cells have evolved to repel foreign genetic material. Therefore, a big bushy molecule designed to look like something that cells might recognize, tolerate and allow in would be a welcome advance. This type of molecule would be a perfect Trojan horse for drug delivery. Dendrimer molecules are not just the wave of the future though. Indeed,

plenty of patents have already been taken out in the area.

Largest patent holder is in the beauty industry

In the 35 years since Dendrimers have been around, the bushy molecules have found a variety of applications. One of the largest patent holders is the cosmetics giant L'Oreal. Not all that surprising since the molecules are good at mimicking hair, skin and nails. But dendrimers are also used for a variety of purposes including dental filler that does not shrink, ink-jet ink that flows more easily through the spray head and membranes for desalinization plants, explains Jørn Bolstad Christensen.

"I was really surprised when I went out to discover in which areas this molecule is used. Sure, I knew that it could do some fantastic things, but not that the areas of their application were so many and so divergent," says Bolstad Christensen, who hopes that the book will stimulate thoughts within the minds of those chemists and biologists alike who have yet to discover these giant and exciting molecules.

Introduction to useful chemistry for non chemists

The book's aim is to serve as a portal for those who might happily benefit from bringing dendrimer chemistry into their own research or areas of development. For this reason he and his co-authors have written the book in a language, so that anyone with a natural sciences background can access its contents. The book undertakes to explain how dendrimers are made, what their properties are and how their properties may be characterized and analyzed.

Provided by University of Copenhagen

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