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The Promising Future of Dendrimers

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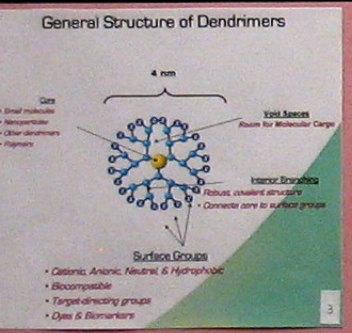
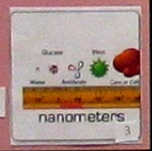
Chemistry 205-002

What Is a Dendrimer?

- Seemingly perfect 3-D, highly branched macromolecule[1].
- Three parts; the core, branches and end groups[1].
- Class of polymer that's well-defined in structure and properties[2].
- This means synthesizer can easily control the properties (size in nanometers, shape, etc.) of dendrimers[2].
- From 1 to over 10 nanometers in size[3].
- Has numerous void spaces[3].



Dendrimers are VERY small[3]

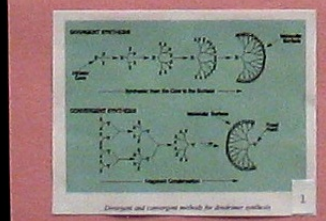


History

- In 1978 Vogtle and coworkers report the first example of "cascade synthesis", and iterative process that formed well-defined and branched products[1].
- In the 1980's, Denkewalter synthesized the first dendrimer, L-lysine-based dendrimer[1].
- Shortly after, PAMAM (Starburst) and PIP dendrimer formed (both by divergent method)[1].
- In the 1990's, Frechet formed the convergent method and then Jeffrey Moore put it to use in forming phenylacetylene dendrimers[1].

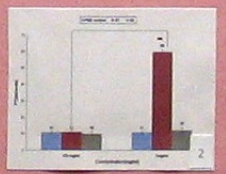
Potential In Drug Delivery

- Show potential as nanocarriers in drug delivery, gene transfection, tumor therapy, and a variety of diagnostics[4].
- Can be made biologically active or inert and are small enough to pass into a cell to deliver material[1].
- Toxicology studies of certain dendrimers showed that 0.5 mg/ml was the max accepted non-toxic range[2].



Each generation doubles the dendrimer's size[3]

Results from toxicity studies (dedrimers G1 and G2 as compared to a non-toxic control)[2]

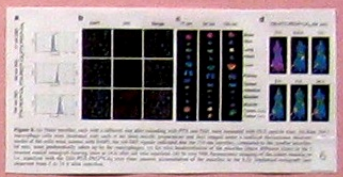


Synthesis

- Divergent: molecule built form core outwards[4].
- Convergent: molecule built from outside, inwards towards the core[4].
- Synthesis is easily obtainable in a standard organic chemistry lab[3].
- Reactants are normally cheap and the process is very cost-effective[1].

Applications Thus Far

- A library of 12 conical dendrons that self-assemble into hollow dendrimers was studied. It reported that they had the capability to encapsulate things in their core and also change shape from hollow spheres to porous columns[5].
- A study involving the use of dendrimers to encapsulate Paclitaxel (a cancer treatment drug) shows the dendrimers ability to carry medicine to the tumor[6].



Smaller dendrimers have the ability to uptake in tumors[6]

Conclusion

- Dendrimers hold great potential for the future of science, especially the medical fields. A key interest is in drug delivery. This spheroid polymer class has the ability to encapsulate drugs and carry them to parts of the body due to their void spaces and highly controllable properties. In addition, their simple and cost-effective synthesis make them an efficient and very viable means of production as a drug delivery system.

References

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