Dendrimers Encyclopedia Article

Dendrimers

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Dendrimers

Traditionally, polymers are long **chains** of monomers, repeated over and over until a specific size range is achieved. Essentially, this process results in a "one dimensional" **molecule** having length but little breadth or width. In addition, each chain is individual grown and the reactions are concurrent, which results in limited control of the exact **molecular weight** and dimensions of the product.

An alternative approach is to grow the polymer in three dimensions to produce tree like structures and this is exactly what chemist Donald A. Tomalia and co-workers accomplished in the late 1970s. They called these compounds "dendrimers" which comes for "dendron", Greek for tree, and polymers. Retaining the allusion to trees, some chemists have adopted the name "arborols" although dendrimer is the preferred name.

In essence, these molecules start with a three dimensional core and, by adding successive layers, rapidly blossom into high molecular weight molecules. They are a molecular example of the doubling process. For example, starting with 1,4-diaminobutane as the core, four acrylonitriles can be added by a conjugate addition of the amine alkene of the acrylonitrile. After **hydrogenation**, each of the four new amines on the ends of the molecule can react with acrylonitrile, resulting in eight new ends. The next generation involves sixteen acrylonitriles and the next 32. The molecule quickly blossoms in size and, because of steric crowding, it adopts a three dimensional or spherical shape. With each generation a separate reaction, control of the domains in the polymer is significantly and exquisitely enhanced.

Probably one of the most exciting aspects of dendrimers is their demonstrated capacity to encapsulate small molecules for controlled release. This property will eventually allow these polymers to act as drug delivery agents at the molecular level. The specificity of the release mechanism will ultimately may allow site specific delivery which will benefit patients undergoing **chemotherapy** for cancer.