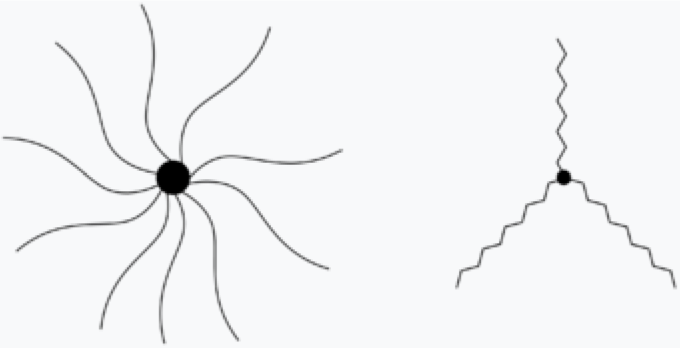
STAR SHAPED POLYMERS



Representations of how star shaped polymers are typically shown

Star-shaped polymers are the simplest class of branched polymers with a general structure consisting of several (at least three) linear chains connected to a central core. The core, or the center, of the polymer can be an atom, molecule, or macromolecule; the chains, or "arms", consist of variable-length organic chains. Star-shaped polymers in which the arms are all equivalent in length and structure are considered homogeneous, and ones with variable lengths and structures are considered heterogeneous.

Star-shaped polymers' unique shape and associated properties, such as their compact structure, high arm density, efficient synthetic routes, and unique rheological properties make them promising tools for use in drug delivery, other biomedical applications, thermoplastics, and nanoelectronics among other applications.

Star-shaped polymers were first reported by John Schaefgen and Paul Flory in 1948 while studying multichain polymers; they synthesized star-shaped polyamides.

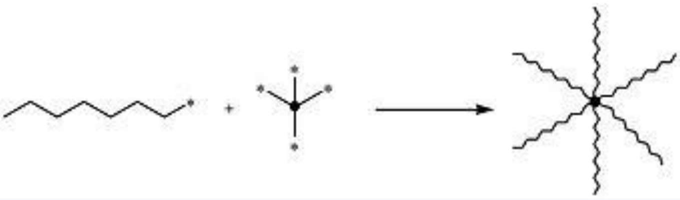
PROPERTIES

Star-shaped polymers consist of a multifunctional center from which at least three polymer chains (arms) radiate. These arms can be chemically identical (homostars) or different (heteroarm stars).

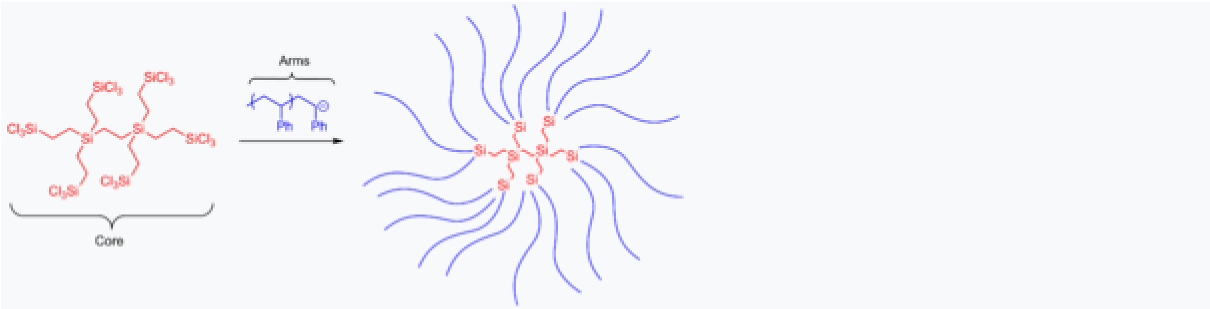
In addition, star-shaped polymers exhibit lower melt temperatures, lower crystallization temperatures and lower degrees of crystallinity than comparable linear analogues.

The unique self-assembly properties of star shaped polymers make them a promising field of research for use in applications such as drug delivery and multiphase processes such as separation of organic/inorganic materials. Generally, star-shaped polymers have higher critical micelle concentrations. The addition of functional groups to the arms of star-shaped polymers as well as selective solvent choice can affect their aggregation properties.

SYNTHESIS



Generalized arm-first synthesis approach. The * symbols represent active functionalities



Star-shaped polymers can be synthesized through various approaches. The most common syntheses include an arm-first approach, in which the living chains are used as the initiators, and a core-first approach, in which the core is used as the initiator.

Other synthetic routes include: Group transfer polymerization, transition metal catalysis, living anionic polymerization and living cationic polymerization etc.

APPLICATIONS

While many studies have been published regarding star-shaped polymers, their commercial applications are limited, but growing constantly as research expands. Some commercial applications of star-shaped polymers include:

Asymmetrical star-shaped polymers have been found to be effective thermoplastic elastomers.

Use as viscosity index improvers in car engine lubricating oils. Star-shaped polymers generally have lower internal viscosities than their linear analogues due to their smaller hydrodynamic radii and radii of gyration. This makes them favorable for use in fluids that require low viscosity such as lubricating oils in car engines.

The low gelation concentration of telechelic and semitelechelic star-shaped polymers has made them useful in the development of new hydrogels for biomaterial applications. This low gelation concentration is caused by an increased number of intermolecular interactions relative to linear analogues due to star-shaped polymers' increased number of functional groups in a given volume.