Condensation, Step-Growth Polymerizations

Polymers build-up stepwise; high degrees of polymerization only at high degrees of monomer conversion

Non-living (non-chain-growth), except in a few cases (T. Yokozawa)

At 100% conversion, either infinite chain length or entirely cyclic structures

Stoichiometric equivalence of functional groups is critical to achieve high conversions

\[ \text{Conversion}^* = c = \frac{N_0 - N}{N_0} \]

\[ \text{DP}_n = \frac{N_0}{N} = \frac{\text{Number of molecules at } t = 0}{\text{Number of molecules at } t = x} \]

\[ \text{DP}_n = \frac{1}{1 - c} \]

* For an AB monomer system, where # molecules = # A or B groups
Achieving Stoichiometric Equivalence—Carothers

Interfacial Polymerization to Achieve Polymerization with Stoichiometric Equivalence at the Interface

In 50% NaOH/H₂O

In toluene

Strong Intramolecular Bonding

Strong Intermolecular Interactions

Always show chain ends—they are diagnostic of the synthesis

Interfacial Polymerization to Achieve Polymerization with Stoichiometric Equivalence at the Interface

n
H₂N

O

H

N

O

C

H

C

H

C

Cl

Cl

H₂N

NH₂

OH

Carothers

http://listverse.files.wordpress.com

[Wallace H. Carothers, 1896-1937]

http://lgallery.hd.org

http://www.uni-regensburg.de

In toluene

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Nylon 6

Also, the placement and type of brackets indicate important information about the synthesis and structure

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Ring-opening Polymerization

A Chain Polymerization Mechanism

Also, the placement and type of brackets indicate important information about the synthesis and structure