Session #28: Homework Solutions

Problem #1

Poly (vinyl chloride) is represented by the formula

\[
\begin{align*}
\text{H} & \quad \text{H} \\
\text{C} & \quad \text{C} \\
\text{H} & \quad \text{Cl}
\end{align*}
\]

Draw molecular structures for tetramers \((n=4)\) of the atactic, isotactic, and syndiotactic forms of PVC.

Solution

(a) atactic:

\[
\begin{align*}
\text{H} & \quad \text{H} \\
\text{Cl} & \quad \text{Cl} \\
\text{C} & \quad \text{C} \\
\text{H}_2 & \quad \text{Cl} \\
\text{Cl} & \quad \text{H}_2
\end{align*}
\]

isotactic:

\[
\begin{align*}
\text{H} & \quad \text{H} \\
\text{Cl} & \quad \text{Cl} \\
\text{C} & \quad \text{C} \\
\text{H}_2 & \quad \text{Cl} \\
\text{Cl} & \quad \text{H}_2
\end{align*}
\]

syndiotactic:

\[
\begin{align*}
\text{H} & \quad \text{H} \\
\text{Cl} & \quad \text{Cl} \\
\text{C} & \quad \text{C} \\
\text{H}_2 & \quad \text{Cl} \\
\text{Cl} & \quad \text{H}_2
\end{align*}
\]
Problem #2

(a) Polyethylene exists either as a linear (straight-chain) polymer or as a branched polymer. Which is the high-density form? Explain.

(b) In visible light high-density polyethylene (HDPE) is opaque (white) while low-density polyethylene (LDPE) is transparent. Explain.

(c) Which form of PE is mechanically more flexible? Explain.

(d) Which form of PE has the higher melting point?

Solution

a) - linear is HDPE
   - straight chains pack better

(b) HDPE straight chains are capable of some degree of crystallization
   ⇒ interface between amorphous and crystalline material scatters visible light
   ⇒ white appearance.

(c) semi-crystalline nature of HDPE adds rigidity
   ⇒ LDPE is more flexible

(d) partial crystallization leads to better packing which in turn implies a higher degree of secondary bonding within the macromolecule
   ⇒ HDPE has the higher melting point