

Condensation Polymerisation

A-Level Chemistry ■ Topic 35

A-Level Chemistry



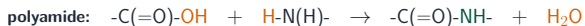
What we will cover

- 1 Condensation polymerisation
- 2 Addition vs condensation
- 3 Finding the monomers
- 4 Degradable polymers



nylon, a polyamide

Condensation polymerisation



every new ester or amide link loses a small molecule (condensation)

In **condensation polymerisation** 缩合聚合, monomers join **and** a small molecule is lost. Each monomer needs **two** reactive groups.

- **polyester** 聚酯 – ester links (diol + diacid)
- **polyamide** 聚酰胺 – amide links (diamine + diacid)

Addition vs condensation

addition polymerisation

- monomer has a **C=C**
 - the double bond opens and the monomers join
 - **nothing else** is lost
- e.g. ethene → poly(ethene)

condensation polymerisation

- each monomer has **two** functional groups
 - a **small molecule** (H_2O or HCl) is lost
 - ester or amide links form
- e.g. a polyester or polyamide

- **addition** 加成聚合 – a $\text{C}=\text{C}$ opens, **nothing** lost
- **condensation** 缩合聚合 – two-group monomers join, a small molecule **lost**

Finding the monomers

polyester (ester links)



break each link; add back $-\text{OH}$ and $-\text{H}$



diol

dicarboxylic acid

The **repeat unit** 重复单元 contains parts of **both** monomers.

To find the **monomers** 单体, break the chain at each ester or amide link and add back $-\text{OH}$ and $-\text{H}$ to the cut ends.

Degradable polymers



- **poly(alkene)s** 聚烯烃 are inert (strong non-polar bonds) – hard to **biodegrade** 生物降解
- polyesters & polyamides **are** biodegradable – their links **hydrolyse** 水解

Worked example – which polymerisation?

A polymer is made from 1,6-diaminohexane and hexanedioyl dichloride. Name the link and say why it is biodegradable.

- Each monomer has **two** functional groups, and a small molecule (HCl) is lost each time $\Rightarrow$ **condensation**.
- $\text{NH}_2 + \text{COCl}$ gives a $-\text{CONH}-$ **amide link** 酰胺键 $\Rightarrow$ a polyamide (nylon-6,6).
- Amide links are **polar** and can be hydrolysed by water, acid or enzymes.
- So the chain breaks back to monomers $\Rightarrow$ **biodegradable**, unlike poly(alkene).

Two functional groups + a small molecule lost $\Rightarrow$ condensation. Addition polymers (all C–C) resist hydrolysis; polyesters and polyamides do not.

Topic 35 – key takeaways

1

Condensation

two-group monomers; a small molecule lost

2

Links

polyesters (ester) & polyamides (amide)

3

Monomers

break the links, add back -OH & -H

4

Degradable

condensation polymers hydrolyse & degrade

Check yourself

- 1 How many reactive groups does a condensation monomer need?
- 2 What link does a polyamide have?
- 3 What is lost in condensation but not addition?
- 4 Why do polyesters biodegrade?



Answers 1. two 2. an amide link 3. a small molecule (water/HCl) 4. their ester links hydrolyse