

Nylon-6, 10

Preparer's Version

Introduction

This demonstration showcases the synthesis of nylon-6,10, a synthetic polyamide, through an interfacial polymerization reaction. Two immiscible solutions are used: 50mL of 0.5M 1,6-hexanediamine in water (the aqueous layer) and 50mL of 0.5M sebacoyl chloride (a diacid chloride) in hexanes (the organic layer). When these two layers are carefully poured into a beaker, they form a distinct interface. At this boundary, a thin film of nylon-6,10 forms almost instantly and can be continuously pulled from the interface using tweezers, making the formation of the polymer dramatically visible in real time. This demonstration not only illustrates fundamental concepts in polymer and organic chemistry, such as nucleophilic acyl substitution and condensation polymerization, but also provides an opportunity to connect microscopic chemical changes to tangible, macroscopic materials.

Safety Hazards

- Personal Protective Equipment:
 - Safety glasses/goggles
 - Nitrile gloves
 - Neoprene gloves
 - Chemical & flame retardant lab coat
- Physical Hazards
 - Sebacoyl chloride is corrosive to metals.
 - Hexanes is toxic to aquatic life with long lasting effects.
 - Hexanes is a highly flammable and volatile liquid and vapor.
- Chemical Hazards
 - 1,6-hexanediamine causes severe skin burns and eye damage, is harmful if swallowed or in contact with skin, and may cause respiratory irritation.
 - Sebacoyl chloride is harmful if swallowed, fatal in contact with skin, causes severe skin burns and eye damage, and may liberate toxic gas upon contact with water.
 - Hexanes causes skin irritation, may be fatal if swallowed or inhaled, may cause drowsiness or dizziness, may cause damage to organs (nervous system) through prolonged or repeated exposure if inhaled, and is suspected of damaging fertility or the unborn child.

Materials

- 50mL 0.5M 1,6-hexanediamine in water
- 2.14mL 97%+ Sebacoyl chloride
- 47.86mL hexanes
- 250mL crystallization dish
- Fine point forceps/tweezers
- Winding stand
- Food coloring (optional)

Safety Data Sheet(s)

- [1,6-hexanediamine, 0.5M](#)
- [Sebacoyl chloride, 97%+](#)
- [Hexanes](#)



Procedure

1. Measure 50mL of 0.5M 1,6-hexanediamine and securely bottle it. Parafilm the bottle cap (it may cause respiratory irritation).
2. Measure 2.14mL of 97%+ sebacoyl chloride and combine with 47.86mL of hexanes. Securely bottle the solution and parafilm the bottle cap.

Tips & Tricks

- If food coloring is requested, add a couple of drops to the 1,6-hexanediamine. Food coloring is aqueous, and therefore will need to be in this solution.
- Use the forceps and winding stand to pull the nylon. If the performer wants to pull by hand, make sure they double glove (nitrile first, neoprene on top of that) due to the corrosivity and dermal toxicity of some reactants.
- Do not pre-make the sebacoyl chloride solution in large volumes; hexanes is a highly volatile liquid that vaporizes quickly. If left to sit for a long period of time, it may potentially pressurize the container.

Clean-Up Procedures

1. For the nylon:
 - a. After washing thoroughly with ethanol, the nylon can be cleaned with deionized water and kept, if desired.
 - b. Otherwise, after being cleaned thoroughly, it can go in the waste carboy.
2. For glassware used for the 1,6-hexanediamine solution:
 - a. Rinse thoroughly with deionized water at least three times and collect the runoff in a waste carboy.
3. For glassware used for the sebacoyl chloride solution:
 - a. Rinse thoroughly with hexanes at least three times and allow to evaporate in the fume hood.
 - b. Rinse thoroughly with acetone at least three times and allow to evaporate in the fume hood.
 - c. Rinse thoroughly with deionized water in the fume hood at least three times and collect the runoff in a waste carboy.
 - i. *If there is trace sebacoyl chloride, it may liberate toxic gas when in contact with water. To be safe, work in the fume hood until you are confident there are no traces of sebacoyl chloride in the labware.*
4. Clean all labware thoroughly with laboratory detergent.