

STUDENT SYNTHESIS PROCEDURE FOR EXPERIMENT B: LIQUID CRYSTALS

Below is the synthesis procedure for EXPERIMENT B included in the Experiment Module of the “NANOYOU Teachers Training Kit in Nanotechnologies” for students aged 14-18.

SAFETY NOTE: Follow school lab safety procedures. The chemicals used in this experiment need to be used accordingly to MSDS specifications. Personal protection must be taken as indicated. As with all chemicals, use precautions. Solids should not be inhaled and contact with skin, eyes, or clothing should be avoided. Wash hands thoroughly after handling. Dispose as indicated. All experiments must be conducted in the presence of an educator trained for science teaching. All experiments will be carried out at your own risk. Aarhus University (iNANO) and the entire NANOYOU consortium assume no liability for damage or consequential losses sustained as a result of the carrying out of the experiments described.

MATERIAL NEEDED:

- Cholesteryl oleyl carbonate (Sigma-Aldrich 151157), see table for quantities
- Cholesteryl pelargonate (Sigma- Aldrich C78801), see table for quantities
- Cholesteryl benzoate (Sigma- Aldrich C75802), see table for quantities
- 4 glass vials (able to hold 10 mL).
- 1 plastic funnel
- 1 hotplate (no stirring needed) or a heat gun or hairdryer
- Paper for cleaning
- 1 balance (if possible with 0.01 g resolution)
- Plastic vessels (for measuring solids on the balance)
- eye protection
- Latex gloves
- 1 spatula



The table below gives quantities of material needed for making **4 different mixtures of liquid crystals**.

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Liquid crystal	Cholesteryl oleyl carbonate	Cholesteryl pelargonate	Cholesteryl benzoate	Temperature (°C)
Type 1	0.65	0.25	0.10	17-23
Type 2	0.45	0.45	0.10	26.5-30.5
Type 3	0.40	0.50	0.10	32-35
Type 4	0.30	0.60	0.10	37-40

PRECAUTIONS

Before using all materials read MSDS sheets carefully. Use these materials with normal chemical precautions according to MSDS. Wear eye protection and gloves. Solids should not be inhaled and contact with skin, eyes or clothing should be avoided. Wash thoroughly after handling. After preparing the liquid crystal, keep in a closed glass vial and do not open or inhale.

PROCEDURE

- Measure the amounts of the **three solids** that are needed using a scale and three different plastic vessels. NB. Clean the spatula well between measurements using some paper!
- Mix the three solids in the glass vial using a plastic funnel. Note that the solids (particularly cholesteryl oleyl carbonate) are quite sticky, so be sure to gently push the solids down the funnel and get as much of the solids as possible removed from the funnel walls. If a lot of solid remains in the spatula or funnel walls, keep both in place as you heat up the glass vial, so it melts and you don't lose it.
- Heat up the glass vial using a hotplate or a heat gun. The hot plate should be set at 185 C. If you don't have any of these, use a hairdryer set at the highest temperature and highest flow. It might take a while to melt the solids. Be patient! **At the end the liquid crystal should look transparent and have the consistency of honey.**

WARNING: Caution should be taken when using a hotplate or heat gun. These should be operated only in the presence of a teacher. The mouth of a heat gun can become very hot, so do not touch it, do not

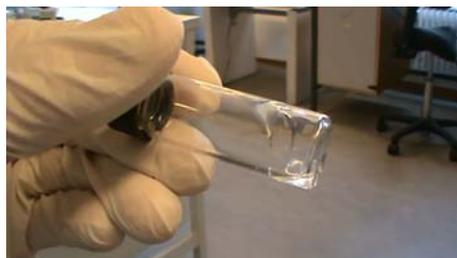


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touch the vial as you heat it, and do not touch it immediately after you have turned the heat gun off. Wait a few minutes before doing so, and always wear gloves.

- While the sample is still liquid, gently move the vial around at an angle with your hands (see Figure) so that the liquid crystal spreads around the vial walls.

- **Clearly mark the vial** with a number corresponding to the type of liquid crystal you have made (1 for Type 1 and so on)



Prepare the four different vials and then test them!

Continue the experiment following the instructions in the Experiment B - Student's worksheet.

CREDIT:

This experiment was adapted from the activity "Preparation of Cholesteryl Ester Liquid Crystals" available at http://mrsec.wisc.edu/Edetc/nanolab/LC_prep/index.htm and from the "Exploring materials: Crystal Liquids" activity developed by the NISE network. www.nisenet.org (Creative Commons Attribution ShareAlike 3.0). The activity was developed for the NISE Network with funding from the National Science Foundation under Cooperative Agreement #ESI-0532536. Any opinions, findings and conclusions or recommendations expressed in this report are those of the authors and do not necessarily reflect the views of the Foundation.



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