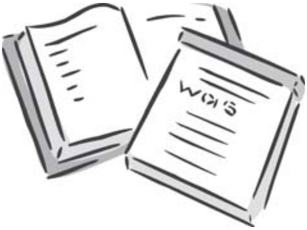
KÉMIA IDEGEN NYELVEN



Kémia angolul

Szerkesztő: MacLean Ildikó

Kedves Diákok!
A 2011/5. számban az előző lapszámban ismertetett tematikának megfelelően két fordítási feladatot kaptok. Az első fordítandó szöveg egy újdonságról számol be, a második pedig ismét a savakkal és bázisokkal foglalkozik. Aki csak az egyik szöveget fordítja le, az is küldje be a dolgozatát, mert pontokat azzal is szerezhet.

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1./

Unusual crystal patterns win chemistry Nobel Prize

The 1453 mosaic at the Darb-i Imam shrine in Esfahan, Iran, bears patterns that are regular but don’t repeat, a feature discovered in matter in 1982 in a crystal, research honored with this year’s chemistry Nobel Prize.

The discovery of a crystal whose atoms are packed in a pattern that never repeats has won Israeli scientist Daniel Shechtman the 2011 Nobel Prize in chemistry. The structures in quasicrystals, as they are known today, are similar but never exactly identical. This patterning is found in 800-year-old Islamic tiling and described in the mathematical sets of English mathematician Roger Penrose.

“He discovered something nobody thought possible,” says chemical engineer Nancy Jackson. “But he stuck to his guns and with time researchers found that this unique crystal structure was actually right,” says Jackson, president of the American Chemical Society.

Quasicrystals are exceedingly strong and are found in particular blends of steel used to make razor blades and surgical instruments. These crystals are also slippery like Teflon and scientists are investigating them for use in coatings for frying pans. Poor conductors of heat, quasicrystals may prove also useful as heat insulators for engines or in devices such as light-emitting diodes.

Shechtman, 70, of the Technion-Israel Institute of Technology in Haifa, made the discovery one April morning in 1982 while investigating a mix of aluminum and manganese. Many in the scientific community scoffed at the initial discovery, and the research wasn't accepted for publication in a scientific journal until 1984.

But eventually, Shechtman's finding forced science to change the definition of a crystal from "a substance in which the constituent atoms, molecules or ions are packed in a regularly ordered, repeating three-dimensional pattern" to "any solid having an essentially discrete diffraction pattern."

Most states of matter are either well behaved and orderly or a disordered mess. Quasicrystals are peculiar because they fall in between – they are regular but never repeating. When Shechtman made his discovery he had just quickly cooled a glowing hot metal, which should have yielded disorder among the atoms. But when he looked at the diffraction pattern created when electrons scattered off his material, he saw something orderly.

Not only was it orderly, but the pattern of dots had an unheard of symmetry. Think of dividing a square with two intersecting lines to get four equal parts. Rotate the square 90 degrees and it looks the same. Rotate it another 90 degrees and it still looks the same. When something can be rotated four times and look exactly the same, it has fourfold symmetry. Prior to Shechtman's discovery, scientists thought crystals could have only one, two, three, four or sixfold symmetry. But the atoms in his metal had fivefold symmetry.

Shechtman said the work was initially met with ridicule. The head of his lab brought him a basic textbook on crystallography, suggesting he read up on the subject.

But once the discovery was finally published, "people jumped on it immediately," says materials scientist John W. Cahn, a NIST colleague and coauthor of the original paper. Other crystallographers who had observed similar patterns without grasping their meaning revisited old lab notes.

In 2009, naturally occurring quasicrystals were discovered for the first time, in a mineral sample from a Russian river.

http://www.sciencenews.org/view/generic/id/334938/title/Unusual_crystal_patterns_win_chemistry_Nobel

2./

Acid-Base Extraction

A widely employed method of separating organic compounds from mixtures in which they are found or produced is that of solvent-solvent extraction. Most reactions of organic compounds require extraction at some stage of product purification. In its simplest form, extraction results from the unequal distribution of a solute between two immiscible solvents. The distribution can be expressed quantitatively in terms of the distribution coefficient K, using the equation shown below for compound A distributed between an organic solvent and water.

If the solute is completely soluble in the organic solvent and completely insoluble in water, then K will have a value of infinity. This situation is never actually attained, but any value of K other than 1.0 indicates that the solute is more soluble in one of the two solvents. When choosing a solvent system for an extraction, some general principles should be kept in mind.

1. The solvents must be immiscible.
2. The solvents must have a favorable distribution coefficient for the component to be separated.
3. The solvents must not react chemically with the components of the mixture, except in the cases of acid and base extraction, discussed below.
4. The solvent must be readily removed from the solute following extraction.

Organic acids and bases can be separated from each other and from neutral compounds by extraction using aqueous solutions of different pH. Most organic acids (e.g., carboxylic acids) are insoluble or slightly soluble in water, but these compounds are highly soluble in dilute aqueous sodium hydroxide because the organic acid reacts with the base, as shown in equation 1.

$$RCO_2H + NaOH \rightarrow RCO_2^{\,-}\,Na^+ \text{ (water soluble salt)} + H_2O \text{ (eq. 1)}$$

Thus, the acid may be selectively removed from a mixture by dissolving the mixture in an organic solvent like dichloromethane (CH_2Cl_2) and then extracting the solution with dilute sodium hydroxide. The organic acid may be recovered from the aqueous solution by acidification (eq. 2), which causes precipitation, followed by filtration.

$$RCO_2^-\,Na^+ + Hcl \rightarrow RCO_2H_{(s)} + NaCl \text{ (eq. 2)}$$

Likewise, organic bases that are insoluble in water may be separated by extraction with dilute hydrochloric acid. These bases (like amines) are soluble in acid due to the formation of a soluble salt, eq. 3.

$$RNH_2 + Hcl \rightarrow RNH_3^{\,+}\,Cl^- \text{ (water soluble salt) (eq. 3)}$$

After the amine has been removed, it may be recovered from the aqueous solution by treatment with base, eq. 4.

$$RNH_3^+\ Cl^- + NaOH \rightarrow RNH_{2\ (s)} + NaCl \text{ (eq. 4)}$$

Most macroscale extractions are carried out using separatory funnels. Microscale extractions, on the other hand, are conveniently performed with conical vials or centrifuge tubes using disposable pipettes to separate the liquid phases.

Experimental Procedure

Weigh out 0.2 grams of a solid mixture containing equal quantities of (1) benzoic acid ($C_6H_5CO_2H$), (2) p-nitroaniline (NO_2-$C_6H_4NH_2$), and (3) naphthalene ($C_{10}H_8$). Dissolve the mixture in 2 mL of dichloromethane in your 5-mL conical vial, warming slightly on the hot plate if necessary.

Add 2 mL of 6 M NaOH, cap the vial, and shake it vigorously. Unscrew the cap slightly to vent (release the pressure that builds up) the vial. Allow the two phases to separate completely. (You should see two distinct layers.)

Using a disposable pipette, remove the lower organic layer and transfer it to a separate flask. Then remove the upper layer and save it in a container marked aqueous base extract. Put the organic layer back into your conical vial and repeat the extraction. Combine the two aqueous base layers and save them. You will recover the organic acid from this aqueous base extract.

Add 2 mL of 6 M HCl to the organic layer in the conical vial, carrying out an extraction like you did with the aqueous base. Put the aqueous acid in another flask and repeat the procedure with a second 2 mL of acid. Combine the two aqueous acid layers and save them to recover the organic base from this aqueous acid extract.

Add 1 mL of fresh dichloromethane to the organic layer in the conical vial. Remove any traces of water by adding a small amount of anhydrous sodium sulfate, swirling the mixture until the solution is no longer cloudy. Separate the liquid from the solid by means of a filter tip pipette. You should now have three separate solutions: (1) aqueous base extract containing organic acid, (2) aqueous acid extract containing organic base, and (3) organic solution containing neutral organic compound.

Cool the aqueous base extract in ice and then neutralize it by adding 6 M HCl gradually with stirring until it is just acidic with litmus paper. This neutralization will require 2-4 mL of HCl. An insoluble solid should be observed at this point. If you do not see a solid, you may need more HCl or you may need to cool your sample further. Isolate the solid by vacuum filtration using a Hirsch funnel, and wash the solid with a **small** amount of **cold** water. Let the solid dry in a sample vial overnight before determining its weight and melting point.

Repeat the above procedure on the aqueous acid extract using 6 M NaOH. After you isolate this solid, allow it to dry overnight in a labeled sample vial before obtaining its weight and melting point.

Evaporate the dichloromethane from the organic layer by boiling off the solvent on a hotplate in the hood. Note that dichloromethane boils at a very low temperature, so your hot plate only needs to be warm. When most of the liquid has evaporated, allow the sample to cool so that the organic neutral compound will crystallize. (Note that the neutral organic compound may melt and appear as a liquid on the hotplate.) Let the solid dry overnight in a sample vial before determining its weight and melting point.

Results:

1. Include a flow chart to describe the separation of the mixture and the isolation of each component.
2. Calculate the percent recovery of each component in the mixture. Assume that each component was present in equal amounts in your sample.
3. Compare the melting points of each sample you isolated with their literature melting points (obtained from a CRC Handbook).
4. Comment on the purity of each recovered component.
5. How could the separation and recovery of the compounds separated be improved?

http://web.centre.edu/muzyka/organic/lab/24_extraction.htm