

- *Учебни опити и демонстрации* •
- *Teaching Chemical Experiment* •

THE ECONOMIC DEMONSTRATOR: PREPARE IT ONCE, USE IT MANY TIMES. IV. $\text{Ni}[\text{HgI}_4]$ - A THERMOCHROMIC SALT

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Abstract. Nickel tetraiodomercurate(II) was synthesized in the reaction between nickel(II) perchlorate and aqueous solution of $\text{K}_2[\text{HgI}_4]$. The green crystals appeared to be thermochromic, changing the colour between green (lower temperature) and brownish-black (higher temperature). The crystals were sealed in an ampoule, following the procedure described earlier.

Keywords: thermochromism, discontinuous, nickel tetraiodomercurate(II), lecture demonstration

Introduction

The goal of the present contribution was to complement earlier series of publications [1-4], the first three of which were published under the same general title, in this journal. The contribution is again devoted to thermochromism (a discontinuous one) in the tetraiodomercurate(II) series of compounds. We first give the basic steps in the synthesis of the compound. After it is synthesized and sealed in a glass ampoule, it may be used for fast and inexpensive demonstrations (it can be used many times) much in the same way as we dealt with the other compounds of this group [3].

Experimental

Preparation of Ni[HgI₄]

To the best of our knowledge, the above compound has not been synthesized earlier. The starting materials for the synthesis were solid Ni(OH)₂·NiCO₃ (basic nickel(II) carbonate), diluted HClO₄ and aqueous solution of K₂[HgI₄] (see [3] for the preparation of the latter). First, about 1g of the basic nickel(II) carbonate was treated with diluted perchloric acid. Slight excess of carbonate was used, so that all of the acid reacted according to



The obtained aqueous solution of nickel(II) perchlorate was treated with K₂[HgI₄]:



The above reaction is obviously possible due to the fact that potassium perchlorate is only slightly water soluble salt. The solid (KClO₄) is filtered off and discarded. The aqueous solution of nickel tetraiodomercurate(II) is carefully evaporated (or, better, dried in a desiccator with silica gel). The green crystals of the product, Ni[HgI₄], are then sealed in a glass ampoule.

Our attempts to synthesize the analogous cobalt compound have, so far, failed.

Demonstration

One needs a hot plate, a beaker filled with water and the sealed ampoule with the thermochromic Ni[HgI₄] compound. The water is heated to about 70-80°C few minutes before the demonstration. The ampoule is inspected at room temperature, inserted into the hot water and inspected again.

Results and discussion

The colours of the two thermochromic forms are given in Fig. 1.

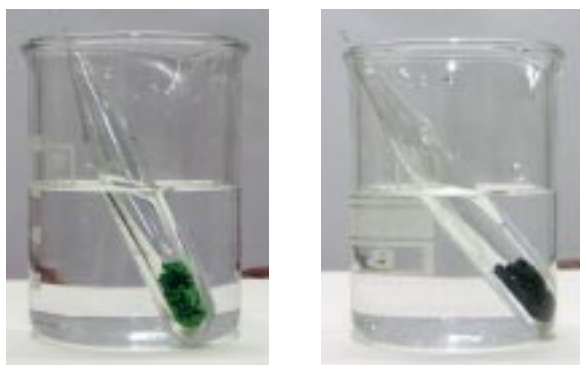


Fig. 1. Discontinuous thermochromism in Ni[HgI₄]: low (left) and high (right) temperature forms

As mentioned above, the compound seems to be a novel one. For that reason, one could at first sight speculate that the colour change might result from a solid-solid phase transition (one of an order-disorder type), as in other tetraiodomercurate(II) compounds [3]. It should be mentioned that the high-temperature colour of $\text{Ni}[\text{HgI}_4]$ resembles the colour of the high-temperature phase of $\text{Cu}_2[\text{HgI}_4]$.

However, while the colour of the low-temperature phase is quite a common colour of simple nickel compounds, the brownish-black colour of the high-temperature phase is very unusual for nickel. This opens the door for a different speculation. One could infer that the compound disintegrates at higher temperatures (these are not very high - some 60 °C or slightly above it), and that the dark brown colour is probably due to elemental iodine. At a lower temperature the original compound slowly (within 24 hours) recombines.

Of course, until any of the above possibilities is proven in a more direct way, this remains to be only a speculation.

Safety tips

The salts of all transition metals are toxic and must be handled with care. This is particularly true for mercury compounds.

Overheating the ampoule should be avoided, as the tetraiodomercurate compounds may disintegrate, thus producing microscopic droplets of extremely toxic elemental mercury.

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ДЕМОНСТРАЦИИ С ТЕРМОХРОМНИ ВЕЩЕСТВА: $\text{Ni}[\text{HgI}_4]$

Резюме. Ако на никел(II) перхлорат се действа с воден разтвор на $\text{K}_2[\text{HgI}_4]$, се получава $\text{Ni}[\text{HgI}_4]$. Това вещество е термохромно — с повишаване на температурата неговите зелени кристали променят цвета си към кафяво-черно.

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