KRATKA SAOPĆENJA | SHORT COMMUNICATIONS

A Note on the Preparation and Optical Properties of Monodispersed Lead Iodate Hydrosols*

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When a beam of white light is passed through an aerosol or a hydrosol, in which the radii of the spherical particles are very uniform and comparable in magnitude to the wave lengths of the incident light, brilliant colours appear in the light scattered at well defined angles. The angular positions of these colours depend on the particle radius and the relative index of refraction of the dispersed particles and the medium. These so-called higher order Tyndall spectra have been used recently for the rapid and precise determination of the particle radius in monodispersed aerosols[1] and sulfur hydrosols.[2] Such determinations are based on the theoretical work of G. Mie[3] and on the numerical computations of La Mer and his associates.

These colloidal systems are of great importance for any theory related to the optics and to the stability of sols, because all theories were evaluated for monodispersed systems.

In the course of a study of the precipitation of lead iodate[4] it was found that lead iodate hydrosols exibit some optical phenomena characteristic for systems of uniform particle size. In view of the fact that only few monodispersed sols have been prepared and described, it seemed of interest to undertake a more detailed study of the optical properties of lead iodate sols. This investigation is now in progress, and in this communication some qualitative observations and preliminary results are described.

The sols were prepared by slowly pouring the solution of potassium iodate into an equal volume of lead nitrate solution. Concentrations of about 0.001 to 0.003 N were found most convenient. It was observed that the way of mixing the precipitating components had great influence on the optical phenomena, although Tyndall spectra could always be noticed. The growth of lead iodate particles was very fast and after about a minute the sols exibited equally brilliant colour bands as La Mer's sulfur sols after 24 hours. The sols were not stable: after about 15 minutes the sedimentation took place and the colour bands began to disappear. The layer of sedimented particles on the bottom of vessel showed also the Tyndall spectra on illumination with a beam of white light.

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To characterize more quantitatively the observed optical phenomena, we have measured the angular intensity distribution of the scattered light with an Aminco light scattering microphotometer[5] at two wave lengths, 436 and 366 mμ (none of the reaction components absorbs at these wave lengths). Cyllindrical cell was used.

The results of such measurements are given in Fig. 1. Plot of the ratio of the intensity of scattered light at two wave lengths for various angles of observation shows characteristic »orders« of Tyndall spectra in agreement with the Mie theory.[1, 2, 3] For the sake of comparison, the results for a polydispersed lead iodate sol are also included.

In order to stabilize the lead iodate monodispersed sols, we have tried to use a protective colloid. With gelatin (0.1 to 1%) we succeeded to maintain the Tyndall spectra for as long as 30 days, but the colour bands were less distinct. That was to be expected in view of the fact that gelatin solution are polydisperse systems. The same effect was observed by Johnson and La Mer[6] on mixing two monodispersed sulfur sols of different particle sizes.

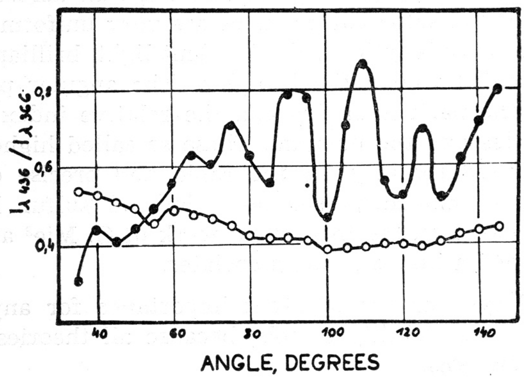

Fig. 1. Ratio of the intensity of scattered light at 436 and 366 m μ as a function of the angle of observation immeditely after the mixing. Black points: monodispersed sol; white points: polydispersed sol. Concentrations of the precipitating components (for monodispersed sol): KJO_3 0.0015 *N*, $Pb(NO_3)_2$ 0.003 *N*.

Another method of stabilization was incidentally discovered. In order to separate larger aggregates (flocks), some sols were filtrated through ordinary filter paper. Such sols exibited very long stability in comparison to the unfiltrated sols, and the angular distribution of scattered light was exactly the same three hours after the mixing and filtration. At present we are not able to offer any explanation of this stabilization.

Knowing the number and the angular positions of the orders of Tyndall spectra, it is possible to determine the particle radius if the relative index of refraction of the particles is known. Unfortunately, we could not find in the relevant literature the value of the refractive index of lead iodate (its determination is in progress). The determination of particle size by the sedimentation method of Johnson and La Mer[6] gave for the radius $r = 800$ m μ for the system on Fig. 1.

It may be noted that the appearance of Tyndall spectra was also observed in silver iodate and lanthanum iodate hydrosols, but to a lesser extent.

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IZVOD

Bilješka o pripremi i optičkim svojstvima monodisperznih hidrosolova olovnog jodata

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Opisan je način pripremanja monodisperznih solova olovnog jodata u vodenim otopinama. Dobiveni solovi pokazivali su jasne i izrazite Tyndallove spektre, karakteristične za sisteme s podjednakim veličinama čestica. Takvi solovi, koji su inače vrlo nestabilni, mogu se uspješno stabilizirati dodatkom želatine (0.1 do 1%), što ide na račun izrazitosti Tyndallovih spektara, ili pak filtracijom kroz obični filtarski papir. Veličina čestica u jednom uzorku, određena metodom sedimentacije, iznosi približno r = 800 mμ.

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