

# Ultrafine-Grained AgBr Crystals as Materials for Optical Filters and Electrooptical Devices

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## Abstract

The experimental data on chemical reduction of AgBr ultrafine-grained crystals (UFGC) under flash action are presented and discussed [1, 2]. It was shown that ultrafine-grained crystals could be used for optical devices, which can change their optical density in milliseconds time interval [3, 4]. Such devices are very important to protect eyes under powerful flash action. It is noted that under action of high intensity light the induction period time can be optimised depending on how long the layer was treated in redox system. The data obtained are in good agreement with thermodynamic theory of new phase nucleation. The examples of original electrooptical devices based on AgBr UFGC and other silver salts are given.

## Introduction

The particular features of AgBr UFGC reduction kinetics under simultaneous action of high intensity light on the photographic material are investigated in this paper. The time of preliminary treatment of the layer into redox system was varied. The samples under consideration are consisted of specially synthesized photographic layer and redox system and were prepared steadily. On the first stage protective colloid, containing silver halide suspension, was obtained, on the second one redox system was prepared and finally they were combined into one working cell. AgBr UFGC with diameter 15-20 nm were used for preparing of silver halide suspension. Initial light absorbance of transparent nonopallescent lippmann emulsion was equal 90-95%.

## Results and Discussion

The curves registered by the oscilloscope (Figure.1) presented the sharp decrease at the moment of flash and then S-like increasing oscillogram with definite induction period.

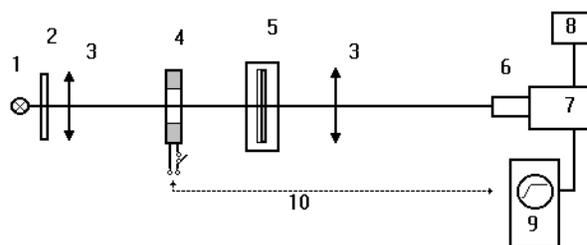


Figure 1. Experimental equipment to investigate kinetics of lippmann emulsion light absorbance under actinic flash action: 1 - inactinic probing light 8V, 2 - optical filter KS-11, 3 - diaphragm, 4 - flash-lamp, 5 - sample, 6 - monochromator DMR-4, 7 - photoamplifier, 8 - high voltage source, oscilloscope S8 -11, 10 - line of synchronization

This induction period was defined as the time period from the beginning of the flash till the oscillogram bending point, which corresponded to the beginning of optical density increase (Figure 2).

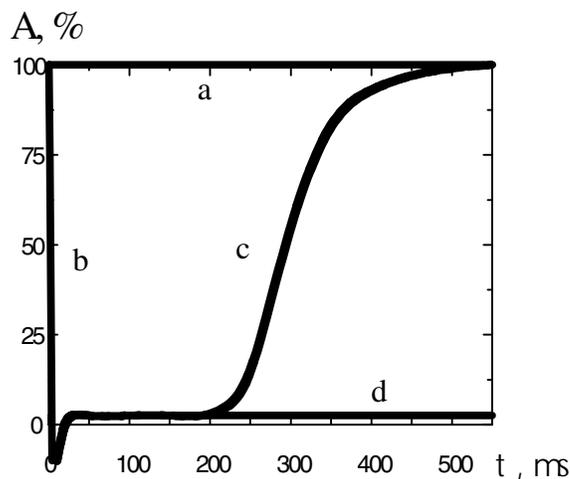


Figure 2. Typical kinetic curve for nonselective reduction of lippmann emulsion in model redox solution. Induction period is 225 ms. a - 100% absorbance signal, b - initial flash-signal, c - oscillogram of the sample, d - control sample (glass covered with gelatine layer).

The dependence of induction period on the time of preliminary treatment of the sample studied into reductive solution before flash action was obtained. To determine the principal form for such dependence reductive solution having low redox potential were used for model experiments. For these conditions the curve has a minimum in 360 s region, the value of induction period being 20 ms (Figure 3.)

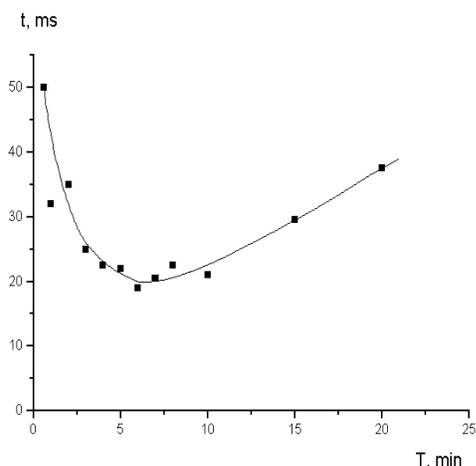


Figure 3. The dependence of induction period on the time of preliminary placement of the sample into reductive solution before flash action.

The increase of induction period in the left part of the curve is caused by the insufficient diffusion of reductive components to the AgBr crystal surface. While diffusion processes are in a progress, induction period becomes

shorter reaching its minimum. Further increase of induction period in the right part of the curve is caused by the processes of spontaneous nucleation (fogging) of silver metallic phase in AgBr. This process is taking place due to decrease of nucleation process thermodynamic barrier caused by the negative redox potential of the reductive system and, consequently, the increasing probability for growing silver particles to reach spontaneously the critical nucleus size.

The electrooptical devices based on AgBr UFGC and other silver salts were patented in 1984 [5,6].

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