Research of AgHal Microcrystals Development Centers Stability

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Abstract

The large importance in a photography has stability of created during chemical sensitization and exposing centers in a developing solution (especially at color development). It is known, that an oxidation of latent image centers is one of the reasons of a photosensitivity reduction.

The method redox buffer solution's treatment was used for investigations of latent image centers stability on emulsion microcrystals of a different type and with a different level of chemical sensitization. Is found out, that the latent image centers stability has extreme character, and the maximum corresponds to an optimum level of chemical sensitization. The oxidation stability of fog centers specifies them mainly non-silver character. Theoretical model of a photosensitivity centers evolution during chemical sensitization is offered.

Experimental

An object of our research was the photographic emulsion AgBr cubic microcrystals with an average equivalent diameter 0.28 μm and variation factor 8 % received by a method of a controlled double jet crystallization. The samples of emulsion were chemically sensitized by sodium thiosulfate in concentration 6×10^{-4} mol/mol Ag with temperature 52°C. The optimum ripening time of emulsion was in an interval 60-90 minutes. The samples with a various degree of chemical sensitization were exposed and treated by redox buffers. For research of a photosensitivity center's redox stability the technique offered by Frei[1] was used. Previously exposed photographic layers before 15 minute processing in a buffer solution were swelled in a KBr solution with concentration 0.001 Ì within 5 minutes. Potential of a buffer solution was varied in an interval from -200 mV up to +500 mV. Standard metholhydroquinone developer was used for samples development. Development time was 8 minutes.

Experimental Results And Discussion

The photosensitive layers with a various ripening degree after exposing were processed in a redox buffer solution. The characteristic curves for ripening time 60 minutes are given in a figure 1. From a figure it is visible, that the control sample has the sensitometric characteristics close with a sample processed in a buffer with potential -100mV, the more negative buffer has reduction ability. The oxidizing buffers not only reduce optical density of the developed image, but also cause fall of contrast factor. From the received sets of a characteristic curve the optical density dependencies with an exposition 2.5 lux on chemical ripening time were received. Such dependencies for samples processed in buffer solutions with various potentials, are submitted in a figure 2. The similar dependencies for fog optical densities are given in a figure 3.

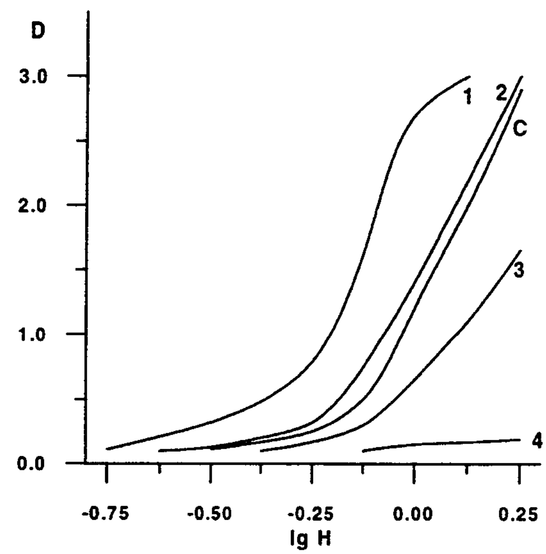

Figure 1. Characteristic curves for chemical ripening time 60 minutes. C - control sample; 1,2,3,4 - samples processed in buffer solutions with potentials -200 mV, -100 mV, +200 mV, +320 mV accordingly.

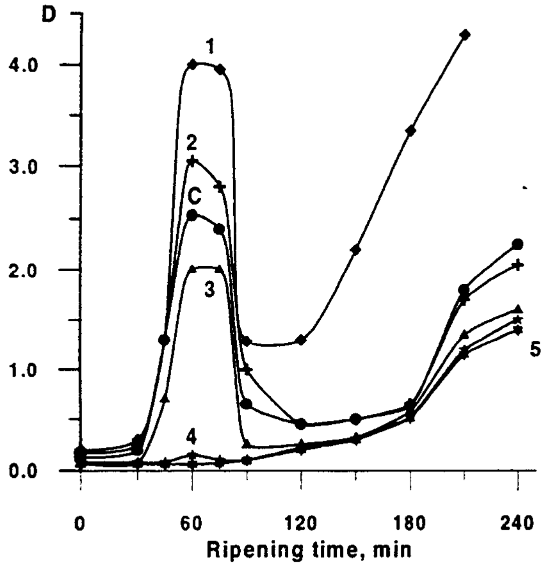

Figure 2. Dependence of optical density with an exposition 2.5 lux for samples processed in buffers with various potentials on ripening time. C - control sample; 1,2,3,4,5 - samples after processing in buffers with potentials -200 mV, -100 mV, +200 mV, +320 mV, +420 mV accordingly.

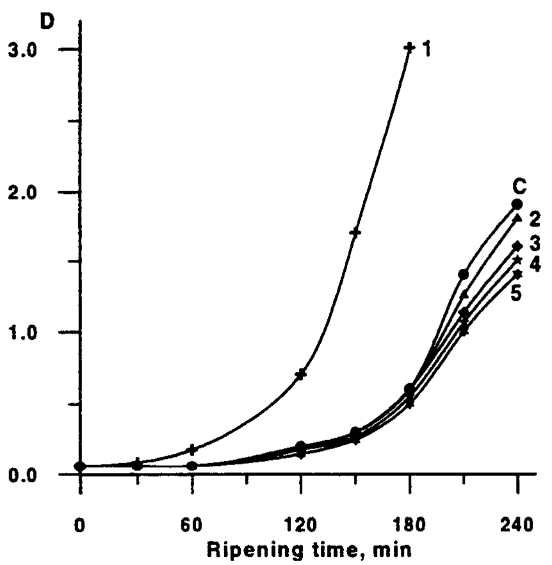

Figure 3. Change of a fog optical density during chemical ripening. C - control sample; 1,2,3,4,5 - samples after processing in buffers with potentials -200 mV, -100 mV, +200 mV, +320 mV, +420 mV accordingly.

Presented in a figure 2 curves have two maxima, and the second parts of curves repeat a course of dependencies in a figure 3. Hence, they are caused by fog centers. From the received results follow, that the fog centers with low degrees of a ripening are not exposed to an oxidation. Fog bleaching is low even by a buffer with potential +420 mV. The buffer having in potential -200 mV restores fog centers with all times of a ripening. The exception is the non-sensitized emulsion. The fog centers arise during sensitization, their reduction ability grows with increase of sensitization time. On a first stage fog centers have a not silver nature, with high degrees of a ripening there is an inclusion of a silver component (it is connected with occurrence of oxidation ability). The exposing does not result in increase of optical density for fog centers. The first maximum in a figure 2 is corresponded with optimum ripening time, and we correlate behavior of this part of a curve to change of photosensitivity centers properties during sensitization. From a figure it is visible, that already with small times of sensitization the exposed photosensitivity centers have ability both to an oxidation, and to reducing. In an optimum of sensitization the exposed sensitivity centers most considerably react with influence to them of redox buffers. On the following site of a curve the decrease of optical density is observed. The explanation of this fact requires additional researches. The brightly expressed ability to an oxidation of exposed sensitivity centers speaks about presence of silver at their composition. The received results may be coordinated with representations, that the photosensitivity centers accept electrons and turn to latent image centers, and the fog centers are large silver sulfide particles. The found out fog centers oxidation with large times of sensitization, most likely, is connected to occurrence of silver from long thermal influence.

References

1. Frei E.A. Die Redox Stabilitat des Latenten Bildes Gegeniiber Beschwerten Losungen. // *Photog. Korres.*, Nr 2. s.21-31 (1969).