# Crystallization of silver chlorobromide T-crystals

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## Abstract

It is considered, that the reception of AgCl and AgBr(Cl) T-crystals is possible only with growth modifiers application. However modifier's use complicates processes of chemical and spectral sensitization. The authors offer the concept of AgHal T-crystals anisotropic growth, consisting in a coalescence of two or more isometric microcrystals with formation of untwinned "coalescence plane", which ensures T-crystals growth. On the basis of this concept a way of emulsions manufacturing with AgBr(Cl) T-crystals is developed. The photographic characteristics of emulsion layers are determined and laws of photographic processing are established.

## Introduction

For many photomaterials the image quality and photographic processing rate are the important properties. These properties can be achieved by application of T-crystals, containing the AgCl in a mix with AgBr. However it is considered, that the reception of AgCl and AgBr(Cl) T-crystals is possible only with application of specific growth modifiers[1]. But their use for microcrystals shape formation much complicates processes of chemical and spectral sensitization.

The authors offer the concept of the AgHal microcrystals anisotropic growth mechanism, consisting in a coalescence of two or more isometric microcrystals with formation untwinned "planes of a coalescence" character, which ensure a T-crystal formation and growth. On the basis of this concept a way of photographic emulsions with T-crystals $AgBr_xCl_{1-x}$ (0.7<x<0.2) manufacturing is developed

## Experimental results and discussion.

On the basis of the T-crystals mechanism formation and growth[2], it is possible to assume, that the AgCl(Br) T-crystals crystallization can be carried out without application of specific modifiers. One of the important processes, proceeding at T-crystals formation is a coalescence of isometric initial microcrystals and the major factor of their formation represents shape, or, most likely, a surface structure of isometric microcrystals. Thus it is important to receive for participating in coalescence octahedral microcrystals or surface structure, adequate such crystals surface. It is possible to believe, that the silver bromide can act as the modifier for reception of T-crystals with the large contents of chloride.

For study of an opportunity of silver chlorobromide T-crystals reception we use a method of a fine emulsions physical ripening. Were used two fine emulsions, containing microcrystals with homogeneous halides ions distribution (bromide concentration from 30 up to 70%) and with the separate AgCl and AgBr phases with the bromide contents from 20 up 50%

For reception of fine emulsions a crystallization process conditions were defined. It is established, that the conditions of a silver chlorobromide microcrystals crystallization with homogeneous distribution of halides ions a little bit differ from conditions of a pure chloride microcrystals crystallization. For reception of the same dispersive characteristics increase of temperature and decrease of reagents rate addition is necessary, that is caused by reduction of a solubility with increase of the silver bromide contents in microcrystals. For reception of fine "core-shell" microcrystals was carried out growth of silver bromide shell on a silver chloride core in conditions of (111) surface formation.

Such fine emulsions were subjected to a physical ripening (aging under certain conditions) and their dispersive characteristics were determined. The received results are resulted on figures 1 and 2.

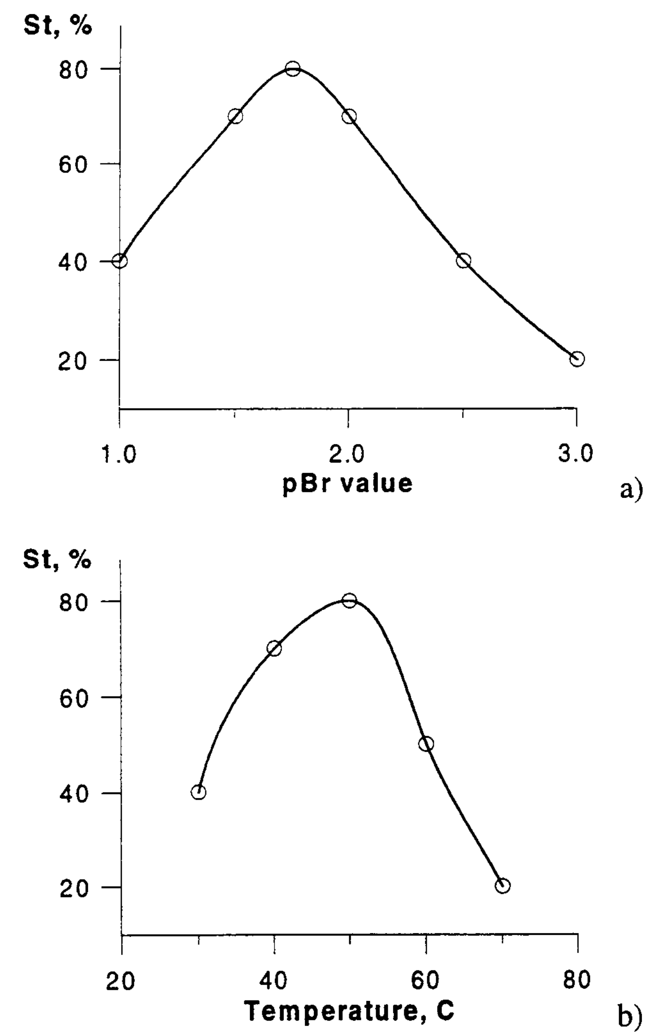


*Fig.1. Dependence of dispersive uniformity at a fine emulsion $AgBr_{0.7}Cl_{0.3}$ physical ripening: a - on pBr value; b - on temperature*

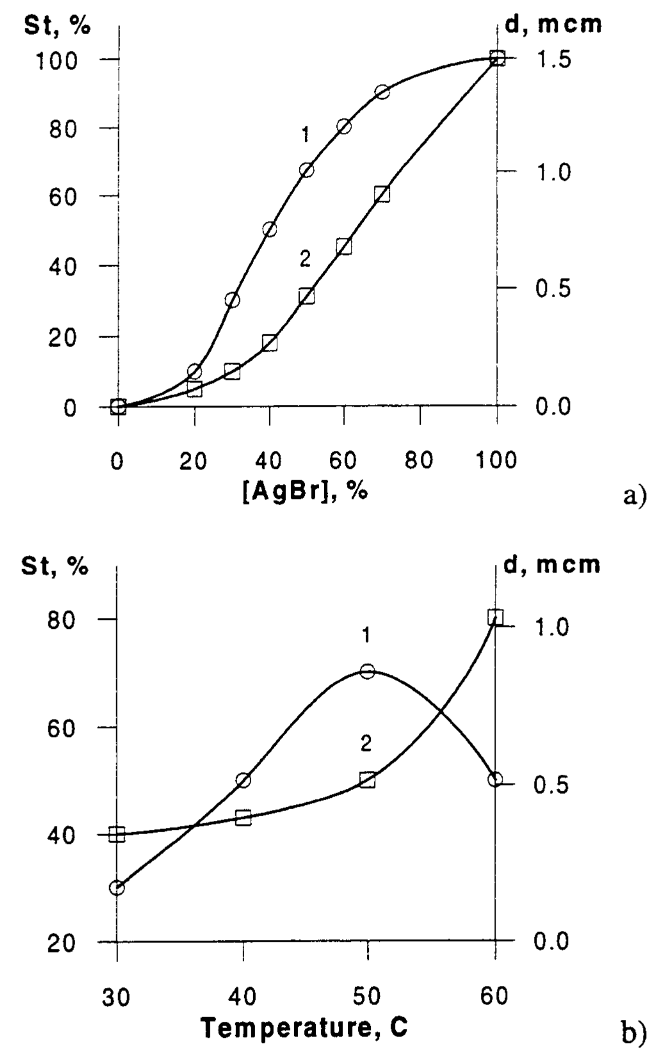


*Fig.2. Influence of shell thickness (a) and a physical ripening temperature (b) for fine AgCl/AgBr emulsion on the AgBr(Cl) T-crystals dispersion characteristics (pBr=1.5).*

Results show, that the increase of bromide concentration in fine AgCl(Br) microcrystals or increase of a silver bromide shell thickness on results in increase of efficiency of T-crystals formation. It is obvious, that increase of bromide concentration is preferable for (111) surface formation and for a coalescence. In case of a silver bromide shell growth on silver chloride core the increase of bromide contain at the surface of a microcrystal comes it nearer (111).

The coalescence of two isometric microcrystals to nucleus of a T-crystal is possible at surfaces structure of these microcrystals, appropriate to a crystallographic (111) plane, but with opposite charge. The opposite charged microcrystal surfaces will be formed at Ostwald ripening of non-uniform emulsion grains.

A rapprochement of opposite charged surface makes possible an electrostatic attraction of microcrystals and their association to one particle without formation structural internal defect - twin plane. But at interaction for such type the re-entering structure will be formed, on which the intensive anisotropic growth of a microcrystal take place. The further growth of a formed T-crystal can proceed mainly on coalescent or diffusion mechanisms, and their combination also possible with different participation of both mechanisms.

On the base of the offered concept there are clear the received results on influence of bromide ion concentration in a AgBr(Cl) microcrystal on efficiency of T-crystals formation. The significant influence to T-crystals formation is rendered by the factors, influencing to a solubility of silver halides (pBr, temperature). This influence has brightly expressed extreme character. The low efficiency of T-crystals formation at high pBr and low temperature is explained by reduction of a solubility and a surface liability of microcrystals, which complicate opposite charged surfaces formation reduce a coalescence probability.

## Conclusions

It is possible to conclude that silver chlorobromide T-crystals can be received in absence of specific modifiers of growth. The efficiency of T-crystals formation depends on amount of silver bromide in microcrystals and conditions of a crystallization realization, that is most likely caused by change of surface or reconstruction of a surface of fine emulsion isometric microcrystals, which participate in T-crystals formation.

## References

1. Thomas P.Tufano and Dominic M.Chan, Process for the preparation of tabular silver chloride emulsions using a grain growth modifier, U.S. Patent 4,804,621 (1989).
2. Larichev T. and Kagakin E., On mechanism of nucleation and growth of the AgHal T-crystals, *Proceeding of IS&T's 48th Annual Conference*, Washington 1995, p.281-282.