

THE EFFECT OF ORGANIC ADDITIVES ON THE SUPERSATURATION OF SOLUTIONS AND THE GROWTH OF SINGLE CRYSTALS OF KDP AND DKDP

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The complexity of speed growth of nonlinear and electro-optic water-soluble KDP (KH_2PO_4) and DKDP (KD_2PO_4) single crystals is that the width of the metastable zone, which determines the stability of supersaturated solutions at a certain growth temperature, is insufficient. An attempt to increase the growth rate due to an increase in supersaturation of the solution, as a rule, leads to spontaneous mass crystallization.

The purpose of this work is to clarify the role and effect of organic additives introduced into the solution on the stability of supersaturated KDP/DKDP solutions. The value $\Delta T = T_m - T$ was taken as a quantitative characteristic of supersaturation, where T_m is the mass crystallization temperature of KDP/DKDP with the additive; T – temperature of mass crystallization KDP/DKDP without additive.

The principle of the choice of additives was based on the ideas obtained in [1] on the hydrophobic mechanism of hydration of nonelectrolytes, which manifests itself in the fact that the hydration of nonelectrolyte increases with the increase in the volume of its nonpolar groups and with an increase in temperature and concentration, hydration of nonelectrolytes is weakened.

As additives carbamide, acetamide (relatively small, poorly hydrated additives), as well as strongly hydrated additives with long aliphatic chains (sodium caprylate and dodecanate, stearic acid) were chosen as additives. Additives were added after dissolving the salt. It was found that very small additives (mole fraction of N less 10^{-5}) of carbamide and acetamide significantly reduce the temperature of mass crystallization of KDP, that is, increase the stability of the solution.

Additions of caprylate and dodecanate of sodium, stearic acid, on the contrary, lead to an increase in the temperature of mass crystallization, i.e., to a decrease in the stability of the solution. Of the additives studied, carbamide (concentration $N = 5 \cdot 10^{-5}$) has the greatest stabilizing effect. It was found that the order of introduction of additives (before or after dissolving the salt) has a significant effect on the stability of supersaturated solutions, up to a change in the nature of the effect on the opposite.

The nature of the effect of the same additives on the supersaturation of solutions during the growth of DKDP crystals proved to be the opposite of their effect when growing KDP, for example, the addition of carbamide and acetamide reduce the stability of DKDP solutions.

References

1. E.S. Titova, O.A. Muraeva. On the hydrophobic mechanism of hydration of nonelectrolytes. Book of Abstracts Conference of Young Scientists at EastWest Chemistry Conference. Lviv, Ukraine October 10-11. 2018 P. 49.