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Study of the Dependence of Reaction Sensitivity on the Chemistry of Complex Formation

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Abstract: this article is devoted to the problems of studying the sensitivity of the reaction from the chemistry of complex formation, the influence of the pH of the medium on the yield of the reaction product. An equation is given for the dependence of the sensitivity of reactions on chemistry, and primary conclusions are made regarding the relationship between sensitivity and chemistry of complex formation.

Key words: complex formation, reaction sensitivity, reaction chemistry, selectivity, selectivity, extinction coefficient, coordination bond.

The article presents the results of a comparison of various methods for determining the sensitivity and, using the example of the interaction of gallium ions with groups and classes of reagents, it is considered between the sensitivity and the chemistry of the complex formation process. For a comparative evaluation of the proposed methods, data on their sensitivity and selectivity are used.

Consideration of the mathematical basis of the methods proposed by a number of researchers for determining the sensitivity of analytical reactions and methods of analysis shows that they all express a directly proportional relationship between the sensitivity and the molar extinction coefficient of the complex (Table 1.).

Table 1

Received. dependencies	After the transformation	Units
$S = \frac{nM}{E}$	$S = \frac{nM}{E}$	$\frac{\gamma}{cm^2}$
$S = -E_K^{\lambda,pH} \pm E_P^{\lambda,pH}$	$S = \frac{(E_K - E_P)V_0 10^{-3}}{C_M A_M V}$	
$a = \frac{D}{E} p A_M 10^3$	$a = \frac{D}{E} p A_M 10^3$	$\frac{\text{мкг}}{cm^2}$
$C_{min} = \frac{D_{min}\mu}{\ell(E_K - \alpha E_P)}$ $S = \frac{D_{min}\mu A_M 10^3}{E_K - \alpha E_P}$	$S = \frac{D_{min}\mu A_M 10^3}{E_K - \alpha E_P}$	$\frac{\text{моль}}{\text{л}}$ $\frac{\text{мкг}}{cm^2}$
$C_{min} = \frac{C_m C_n}{D_m D_n} D_{min}$	$C_{min} = \frac{D_{min}\mu}{E_K - \alpha E_P}$	$\frac{\text{мкг}}{\text{мл}}$

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Molar extinction coefficients are related to the structure of the complexes; therefore, the question of the influence of the chemistry of the complexation process on the sensitivity of analytical reactions is considered.

If in general form the process of interaction of gallium with organic reagents is written:

$\mu M(OH)r + \alpha HiR \leftrightarrow \{M(OH)r\text{-}q\}\mu\ (Hi\text{-}nR)\alpha + (n\alpha - \mu q)H + \mu q H_2O$ (1)

then the dependence of sensitivity on chemistry can be expressed as follows:

$$\gamma = \frac{(C_K C_M)^{\frac{1}{\mu}} h^{n\alpha\mu q}}{\left[K_p (C_R - \alpha C_K)\right]^{\frac{1}{\mu}} \varphi \varphi^{\frac{\alpha}{\mu}}} \quad (2)$$

It follows from expression (2) that the smaller the number of freely evolved hydrogen ions and the lower the pH of maximum complexation, the greater the sensitivity of the reaction.

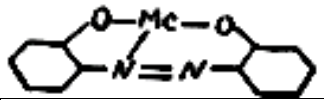
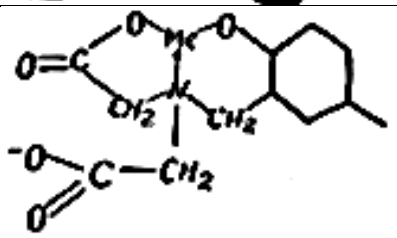
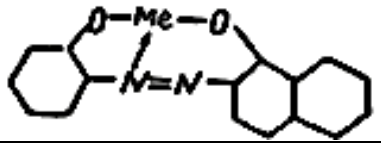
Since the formation of complexes at lower pH values is due to their greater strength, it is also of interest to establish the relationship between the pH of the maximum yield of the reaction product and the amount of metal ion binding into the complex. For equation (1), this dependence has the form:

$$S = \frac{B \varphi^{\mu} \varphi^{d}}{h^{n\alpha - \mu q}} \quad (3)$$

Using expression (3) and the data of Table 2, it can be shown that the reagents that form two valence and at least one coordination bond reach the pH of the maximum yield of the reaction product in a narrower pH range, due to faster binding of the metal into the complex, due to which they turn out to be more selective and analytically more promising.

The data obtained can be used in the synthesis and selection of reagents for gallium.

Table 2

Reagent	**The proposed structure of the complex**	**pH**	**Sensitivity**
PWG		1,5	0,01
Xylenol orange		1,5	0,01
KHTZ “C”		2,0	0,01

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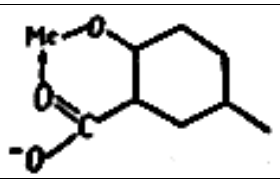
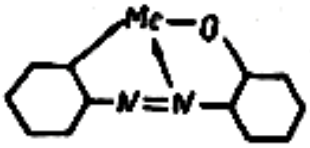
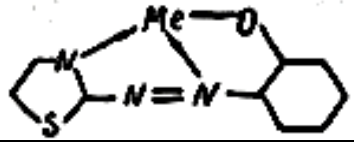
Alberon		3,0	0,02
STEAM		4,5	0,02
4 – COOH TAP		4,5	0,015

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