

Optimization of bromine-emerging etching compositions $K_2Cr_2O_7$ –HBr-ethylene glycol for forming a polished surface of CdTe, $Zn_xCd_{1-x}Te$ and $Cd_xHg_{1-x}Te$

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The chemical dissolution of the CdTe single crystals and $Zn_xCd_{1-x}Te$, $Cd_xHg_{1-x}Te$ solid solutions in aqueous solution of $K_2Cr_2O_7$ –HBr-ethylene glycol in reproducible hydrodynamics conditions has been investigated for the first time. The graphic dependences "etchant concentration — etching rate" have been charted and determined the concentration limits of polishing etchant. It was demonstrated that the dissolution process of these materials is limited by the diffusion stages. The influence of the nature of the solid solutions of the $Zn_xCd_{1-x}Te$ and $Cd_xHg_{1-x}Te$ on the rate and character of their chemical etching was established. The etchants composition and condition of realization of chemical-dynamic polishing process of these semiconductors were optimized.

Keywords: chemical etching, solid solutions, cadmium telluride, etchant, dissolution rate, chemical-dynamic polishing.

В воспроизводимых гидродинамических условиях впервые исследован характер химического растворения монокристаллов CdTe и твердых растворов $Zn_xCd_{1-x}Te$ и $Cd_xHg_{1-x}Te$ в водных растворах $K_2Cr_2O_7$ –HBr-этиленгликоль. Построены диаграммы "состав травителя — скорость травления" и определены концентрационные границы полирующихся травителей. Показано, что процесс растворения указанных материалов лимитируется диффузионными стадиями. Установлено влияние природы твердых растворов $Zn_xCd_{1-x}Te$ и $Cd_xHg_{1-x}Te$ на скорость и характер их химического травления. Оптимизированы составы травителей и режимы проведения процесса химико-динамического полирования указанных полупроводников.

Оптимізація складів бромвиділяючих травників $K_2Cr_2O_7$ –HBr–етиленгліколь для формування полірованої поверхні CdTe, $Zn_xCd_{1-x}Te$ та $Cd_xHg_{1-x}Te$. М.В.Чайка, З.Ф.Томашик, В.М.Томашик, Г.П.Маланич, А.А.Корчовий.

У відтворюваних гідродинамічних умовах вперше досліджено характер хімічного розчинення монокристалів CdTe та твердих розчинів $Zn_xCd_{1-x}Te$ і $Cd_xHg_{1-x}Te$ у водних розчинах $K_2Cr_2O_7$ –HBr-етиленгліколь. Побудовано діаграми "склад травника — швидкість травлення" та визначено концентраційні межі поліруючих травників. Показано, що процес розчинення вказаних матеріалів лімітується дифузійними стадіями. Встановлено вплив природи твердих розчинів $Zn_xCd_{1-x}Te$ та $Cd_xHg_{1-x}Te$ на швидкість і характер їх хімічного травлення. Оптимізовано склади травників та режими проведення процесу хіміко-динамічного полірування вказаних напівпровідників.

1. Introduction

II-VI semiconductor materials, in particular CdTe and $\text{Zn}_x\text{Cd}_{1-x}\text{Te}$ and $\text{Cd}_x\text{Hg}_{1-x}\text{Te}$ solid solutions possess a wide range of physicochemical properties and they are served for creation IR photodetectors, including the multicomponent lines and matrixes, detectors of γ -radiation and optoelectronic elements [1, 2]. The work of such devices depends not only on the physical and chemical characteristics of single crystals, but also on the chemical composition, structural perfection and geometry of their surface, which results in extremely high requirements for their quality. To solve these problems it is necessary to develop the etchant with given properties, such as the rate of chemical dissolution of the material, roughness of the surface and other specific parameters. In the process of creating the working elements of the electronic devices, the stage of chemical processing of single crystals is particularly important, the main task of which is to remove the broken layer formed as a result of previous mechanical etching, as well as to obtain high-quality, maximally structurally perfect and homogeneous chemical composition of the surfaces [3]. These problems are successfully solved by chemical etching of semiconductor wafers, in particular by chemical-dynamic polishing (CDP) [4].

For II-VI semiconductors the bromine-based mixtures are most often used, among which the most common are solutions of Br_2 in CH_3OH or HBr [5-8]. However, the high rate of material removal and the considerable toxicity of their components lead to the research the new, less toxic etchants with low dissolution rates of the semiconductors. The analysis of literature data shows that etching solutions that contain the dichromate ions and bromic acid are characterized by low dissolution rates of II-VI and III-V semiconductors with high quality of the obtained polished surface [9, 10].

The authors [10] found that the chemical etching of InSb by the $3\text{K}_2\text{Cr}_2\text{O}_7:1\text{HBr}:2\text{HCl}$ etching solutions can significantly improve the surface quality of investigated single crystals and reduce some defects. The etching of InAs single crystals in the $\text{K}_2\text{Cr}_2\text{O}_7\text{-HBr-oxalic acid}$, $\text{K}_2\text{Cr}_2\text{O}_7\text{-HBr-HCl-H}_2\text{O}$ and $\text{K}_2\text{Cr}_2\text{O}_7\text{-HBr-acetic acid}$ (Trilon B) bromine-emerging solutions has been studied in [11-13]. It has been found that such etchants have low dissolution rate, which is in the range from 0.1 to $8.5 \mu\text{m}\cdot\text{min}^{-1}$. Most solutions of these systems form a mirrored, pol-

ished surface, and the area of polishing solutions on the Gibbs diagram increases with successive replacement of solvents in the series: acetic acid \rightarrow trilon B \rightarrow chloride acid \rightarrow oxalic acid.

The chemical etching of II-VI semiconductor crystals by the solutions, which include dichromate ions and inorganic acid, the literature contains only a few data about their using for etching the CdTe surface. The kinetics and mechanism of CdTe etching by the $\text{K}_2\text{Cr}_2\text{O}_7\text{-H}_2\text{SO}_4\text{-H}_2\text{O}$ and the $\text{K}_2\text{Cr}_2\text{O}_7\text{-HCl-H}_2\text{O}$ mixtures have been investigated in [14, 15]. It was established that etching rate in these solutions is limited by the rate of tellurium film dissolution, which is formed at the chemical interaction of the CdTe and etchant. With the increase in the oxidizing capacity of the solution, that is, with the increase in the content of $\text{K}_2\text{Cr}_2\text{O}_7$, the CdTe etching rate increases. The systematic researching of the chemical processing semiconductors of II-VI semiconductors in such etchants was not performed, but our previous exploring showed the prospect for using these etchant in CDP and selective etching.

The purpose of this work is to experimentally investigate the chemical dissolution of CdTe , $\text{Zn}_x\text{Cd}_{1-x}\text{Te}$ and $\text{Cd}_x\text{Hg}_{1-x}\text{Te}$ single crystals in the $\text{K}_2\text{Cr}_2\text{O}_7\text{-HBr-ethylene glycol (EG)}$ etching compositions, the charting of the diagrams "etchant concentration — etching rate", and the determination of the concentration limits of etching compositions by the nature of their action on the semiconductors surfaces, the observation of kinetics and setting the limiting stages of the dissolution process, the optimization of the compositions of the developed slow polishing etchants and the regimes of conducting the CDP of the researched materials.

2. Experimental

Regularities of the CdTe and $\text{Zn}_x\text{Cd}_{1-x}\text{Te}$ and $\text{Cd}_x\text{Hg}_{1-x}\text{Te}$ solid solutions dissolution in the $\text{K}_2\text{Cr}_2\text{O}_7\text{-HBr-EG}$ etching solutions were investigated under reproducible hydrodynamic conditions using a rotating disc and a device for CDP at $T = 285\text{--}301 \text{ K}$ at the speed of disc rotation $\gamma = 27\text{--}109 \text{ min}^{-1}$. Such undoped single crystals were used for experimental investigation: CdTe , $\text{Zn}_{0.1}\text{Cd}_{0.9}\text{Te}$ and $\text{Cd}_{0.2}\text{Hg}_{0.8}\text{Te}$, which have been grown by Bridgman method, and $\text{Zn}_{0.04}\text{Cd}_{0.96}\text{Te}$ obtained from the gas phase. The samples were characterized by the surface area of about 0.5 cm^2 and the thickness of 1.5 to 2 mm and were cut from the

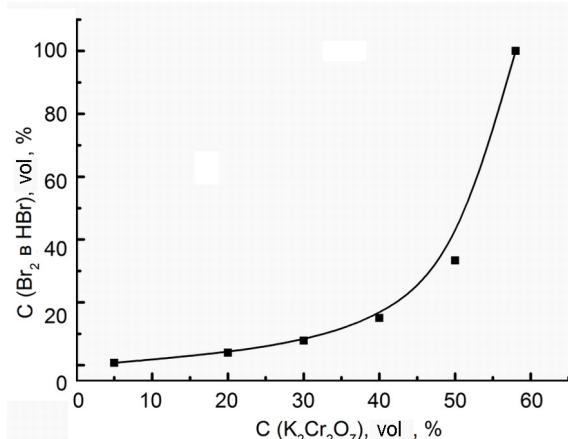
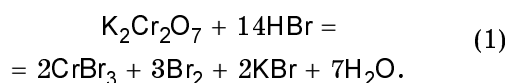


Fig. 1. Concentration dependence of the Br_2 content in HBr (vol. %) in aqueous solutions of the $\text{K}_2\text{Cr}_2\text{O}_7$ -HBr system ($T = 295 \text{ K}$, $\gamma = 82 \text{ min}^{-1}$).

single-crystalline ingots. Before the realization of CDP process, the disturbed layer with thickness from 80 to 100 μm was removed from the surfaces of plates that were previously smoothed and mechanically polished by the etchant of (10–15) wt.% of I_2 in the CH_3OH . The dissolution rate was determined by the thickness reduction of the single crystals before and after etching using 1-MIGP time indicator with precision $\pm 0.5 \mu\text{m}$. Four samples that were attached in fluoroplastic holder and held it wide open were etched simultaneously. Thus all samples were in one plane, evenly etched and avoiding turbulent flow etchant. Etching mixtures were prepared using 10.9 % high grade aqueous solution of $\text{K}_2\text{Cr}_2\text{O}_7$, 40 % high purity HBr and high grade EG. Before the etching, all solutions were allowed to stand during two hours to establish equilibrium of chemical reaction:



Microstructures of samples surface after the etching were investigated with white light using metallographic microscope MIM-7 with 8 Mpix digital video camcorder eTREK DCM 800. The morphology of the polished surfaces of the single crystals was examined by atomic force microscopy (AFM). In this case, we used tapping mode imaging on a NanoScope IIIa Dimension 3000 scanning probe microscope (Digital Instruments/Bruker Corp.) under room conditions with commercial NCH silicon cantilever probes (Nano World, nominal probe tip radius of down to 10 nm).

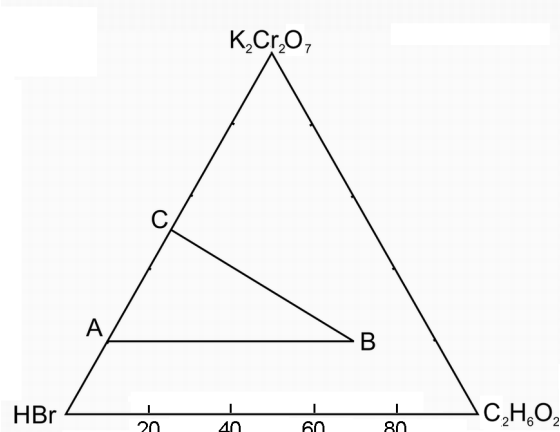


Fig. 2. Investigated interval of the solutions of the $\text{K}_2\text{Cr}_2\text{O}_7$ -HBr-ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$) system.

3. Results and discussion

Previous experiments have found that bromine, which is released as a result of the interaction of the starting components of the etching mixture, dissolves in HBr excess and forms etching compositions that are similar in composition and properties to Br_2 -HBr solutions. Chemical interaction of the CdTe , $\text{Zn}_x\text{Cd}_{1-x}\text{Te}$ and $\text{Cd}_x\text{Hg}_{1-x}\text{Te}$ with etchants was investigated in the concentrating range of 5–60 vol. % $\text{K}_2\text{Cr}_2\text{O}_7$ in HBr. The choice of such interval of the solutions is theoretically justified by calculations of the content of Br_2 in HBr according to the reaction (1). It was found that within the composition 59 $\text{K}_2\text{Cr}_2\text{O}_7$ + 41 HBr (vol. %), the initial components completely react, and Br_2 stops evolving (Fig. 1). It has been established that for the $\text{Cd}_{0.2}\text{Hg}_{0.8}\text{Te}$ single crystals the polishing solutions are formed in the range of concentrations of 20–50 vol. % $\text{K}_2\text{Cr}_2\text{O}_7$ in HBr, for $\text{Zn}_{0.04}\text{Cd}_{0.96}\text{Te}$ and $\text{Zn}_{0.1}\text{Cd}_{0.9}\text{Te}$ in the range of 20–45 vol. % $\text{K}_2\text{Cr}_2\text{O}_7$ in HBr, and for CdTe in the range of 25–45 vol. % $\text{K}_2\text{Cr}_2\text{O}_7$ in HBr. In these etchants the low dissolution rates in the range of 4–9 $\mu\text{m}\cdot\text{min}^{-1}$ are remained, and the surface of all the single crystals that have been etched by them are polished up to the mirror luster. Consequently, the range 20–50 vol.% $\text{K}_2\text{Cr}_2\text{O}_7$ in HBr became a worker for the selection of the third component (ethylene glycol, EG) content. The last was used as a complexing agent to improve the dissolution of reaction products and to reduce the rate of etching which is due to its high viscosity and low ionization constant.

The chemical interaction of the CdTe and $\text{Zn}_x\text{Cd}_{1-x}\text{Te}$ and $\text{Cd}_{1-x}\text{Hg}_x\text{Te}$ solid solutions single crystals was investigated in the range

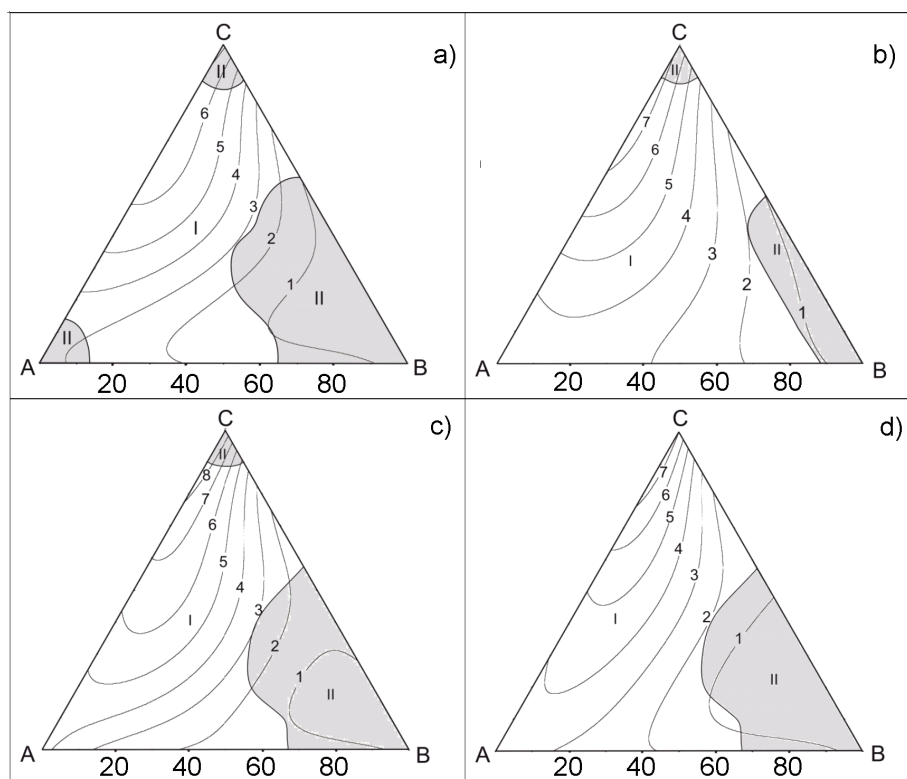


Fig. 3. Concentration dependences ($T = 294$ K, $\gamma = 82$ min $^{-1}$) of the etching rate ($\mu\text{m}/\text{min}$) of CdTe (a) and $\text{Zn}_{0.04}\text{Cd}_{0.96}\text{Te}$ (b), $\text{Zn}_{0.1}\text{Cd}_{0.9}\text{Te}$ (c) and $\text{Cd}_{0.2}\text{Hg}_{0.8}\text{Te}$ (d) solid solutions at the volume ratio of the components $\text{K}_2\text{Cr}_2\text{O}_7$ –HBr–ethylene glycol at the vertices A, B, C, respectively: A — 20:80:0; B — 20:20:60; C — 50:50:0 (area I — polishing and II — non-polishing etchants).

of the solutions limited by the ABC concentration triangle (Fig. 2), at the apices of which the volume content of $\text{K}_2\text{Cr}_2\text{O}_7$ –HBr–ethylene glycol is, respectively: A — 20:80:0; B — 20:20:60; C — 50:50:0. Fig. 3 demonstrates the concentration dependences of the dissolution rate CdTe, $\text{Zn}_{0.04}\text{Cd}_{0.96}\text{Te}$, $\text{Zn}_{0.1}\text{Cd}_{0.9}\text{Te}$ and $\text{Cd}_{0.2}\text{Hg}_{0.8}\text{Te}$ in solutions of the $\text{K}_2\text{Cr}_2\text{O}_7$ –HBr–EG system. Diagrams "etchant concentration — etching rate" were charted using the simulation method of the experiment by the mathematical planning [16] at $T = 294$ K and disk rotation $\gamma = 82$ min $^{-1}$. The regions with polished (region I) and unpolished (region II) solutions with respect to the investigated semiconductors were detected. Fig. 3 depicts that the maximum dissolution rates ($7\text{--}8$ $\mu\text{m}\cdot\text{min}^{-1}$) of all single crystals are observed in the solutions enriched in $\text{K}_2\text{Cr}_2\text{O}_7$ (near the angle C). Introducing of EG into the composition of the etchant (near the angle B — etchants with a maximum content of the organic component) leads to a significant reduction in the etching rate — to $0.5\text{--}1.0$ $\mu\text{m}\cdot\text{min}^{-1}$. The isolines of the etching rates for all samples are similar, thus indicating the same mecha-

nism of dissolution of single crystals, which is probably determined by the dissolution of the anion tellurium sublattice.

It can be seen (Fig. 3) that the dissolution rate for the above single crystals is small (from 0.4 to 9.0 $\mu\text{m}\cdot\text{min}^{-1}$). The rate of CdTe CDP is less than one of the based on its solid solutions ($0.4\text{--}7.3$ $\mu\text{m}\cdot\text{min}^{-1}$). With increasing of Zn content in the solid solution, the rate of CDP increases and the quality of the polished surface improves. Thus, $\text{Zn}_{0.04}\text{Cd}_{0.96}\text{Te}$ dissolves at a rate of $0.5\text{--}7.5$ $\mu\text{m}\cdot\text{min}^{-1}$, and $\text{Zn}_{0.1}\text{Cd}_{0.9}\text{Te}$ dissolves at a rate of $0.7\text{--}9$ $\mu\text{m}\cdot\text{min}^{-1}$. The rate of $\text{Cd}_{0.2}\text{Hg}_{0.8}\text{Te}$ etching is within the range of $0.4\text{--}7$ $\mu\text{m}\cdot\text{min}^{-1}$. It was established that the areas of polishing etchants occupy most of the studied interval, and the polishing rates are within the range: $1.8\text{--}6.7$ $\mu\text{m}\cdot\text{min}^{-1}$ for CdTe; $1.7\text{--}7.5$ $\mu\text{m}\cdot\text{min}^{-1}$ for $\text{Zn}_{0.04}\text{Cd}_{0.96}\text{Te}$, $1.8\text{--}7.9$ $\mu\text{m}\cdot\text{min}^{-1}$ for $\text{Zn}_{0.1}\text{Cd}_{0.9}\text{Te}$ and $1.9\text{--}7$ $\mu\text{m}\cdot\text{min}^{-1}$ for $\text{Cd}_{0.2}\text{Hg}_{0.8}\text{Te}$.

For the polishing etchant of the composition (vol. %): (35 $\text{K}_2\text{Cr}_2\text{O}_7$ + 50 HBr + 15 EG) we charted the dependences of the CdTe, $\text{Zn}_x\text{Cd}_{1-x}\text{Te}$ and $\text{Cd}_{1-x}\text{Hg}_x\text{Te}$ dissolu-

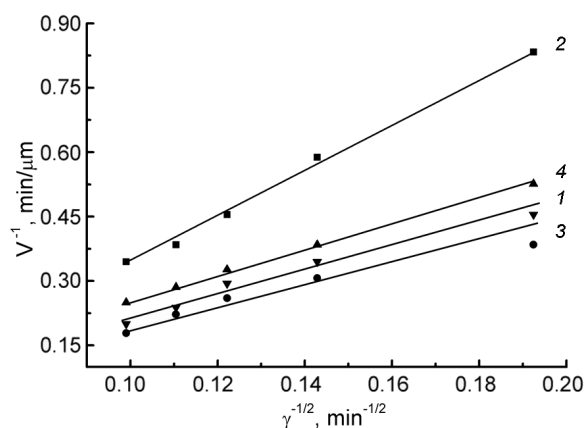


Fig. 4. Dependences of the CdTe (1), $\text{Zn}_{0.04}\text{Cd}_{0.96}\text{Te}$ (2), $\text{Zn}_{0.1}\text{Cd}_{0.9}\text{Te}$ (3), and $\text{Cd}_{0.2}\text{Hg}_{0.8}\text{Te}$ (4) dissolution rate ($\mu\text{m}\cdot\text{min}^{-1}$) on the speed of the disk rotation ($T = 294\text{ K}$) in a solution containing (vol. %): 35 $\text{K}_2\text{Cr}_2\text{O}_7$ + 50HBr + 15 ethylene glycol.

tion rate on the speed of the disc rotation in the coordinates $v^{-1} - \gamma^{-1/2}$ [4,17]. These curves may elucidate the character of the dissolution processes occurring during the dissolution of semiconductors, and to determine which stage (diffusion or kinetic) is limiting and limits the velocity of the heterogeneous dissolution process. The rate of chemical dissolution can be expressed by the equation: $v^{-1} = 1/kC_0 + (a/DC_0) \gamma^{-1/2}$, where k is the reaction rate constant, C_0 is the active component concentration, D is the diffusivity in the solution and a is a constant.

When the process is diffusion-limited $k > 0$ and the first term of the equation becomes zero, so the dependence of $v^{-1} - \gamma^{-1/2}$ passes through the zero of the coordinates. In the case of limiting the process by the chemical reaction $DC_0 > a$ and the second term of the equation is zero; then the specified dependence becomes parallel to the X axis. Under a combined mechanism of the process, the line or its extrapolation cuts off a certain portion of the Y axis equal to $1/kC_0$.

Fig. 4 shows that the process of dissolution of the CdTe and $\text{Zn}_{0.1}\text{Cd}_{0.9}\text{Te}$ and $\text{Cd}_{0.2}\text{Hg}_{0.8}\text{Te}$ solid solutions are characterized by a monotypic mechanism and limited by diffusion stages, as the appropriate dependence of the dissolution rate versus mixing ($\gamma = 27\text{--}110\text{ min}^{-1}$) at $T = 295\text{ K}$ could be extrapolated to zero coordinate. The dissolution process of $\text{Zn}_{0.04}\text{Cd}_{0.96}\text{Te}$ passes through a combined mechanism with

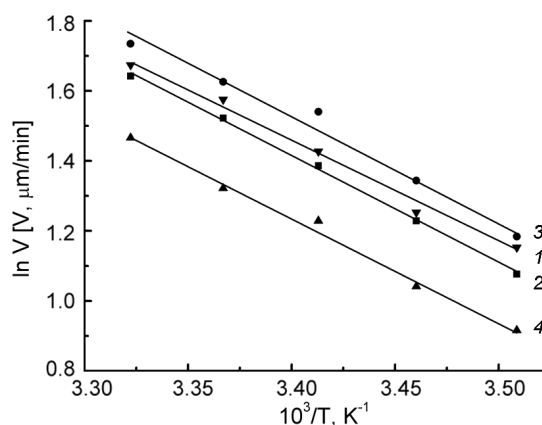


Fig. 5. Dependences of the CdTe (1), $\text{Zn}_{0.04}\text{Cd}_{0.96}\text{Te}$ (2), $\text{Zn}_{0.1}\text{Cd}_{0.9}\text{Te}$ (3), $\text{Cd}_{0.2}\text{Hg}_{0.8}\text{Te}$ (4) dissolution rate ($\mu\text{m}\cdot\text{min}^{-1}$) versus temperature ($\gamma = 82\text{ min}^{-1}$) in solution containing (vol. %): 35 $\text{K}_2\text{Cr}_2\text{O}_7$ + 50HBr + 15 ethylene glycol.

a predominance of diffusion stages, since the corresponding line crosses the Y axis.

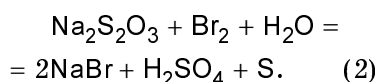
The temperature dependence of the dissolution rate is described by the Arrhenius equation: $k = C_E e^{-E_a/RT}$, where k is the reaction speed constant, C_E is a preexponential factor (collisions frequency of the particles), E_a is the energy of the activation process. The dependences of the semiconductors dissolution rate versus the temperature of the solution in the interval $T = 285\text{--}301\text{ K}$ ($\gamma = 82\text{ min}^{-1}$) were investigated in order to confirm the data obtained from the dependences $v^{-1} - \gamma^{-1/2}$ (Fig. 5) and the value of the apparent activation energy (E_a) and the logarithm of the preexponential factor ($\ln C_E$) (Table 1) were calculated. As can be seen from the Table 1, the calculated values of E_a of the dissolution for of all single crystals are within the range of $24.4\text{--}25.5\text{ kJ}\cdot\text{mol}^{-1}$, that is, they do not exceed $30\text{ kJ}\cdot\text{mol}^{-1}$; this fact indicates on the limiting of the dissolution by diffusion stages.

Using AFM (Fig. 6), we examined the surface morphology of these samples after CDP. For example, the average arithmetic surface roughness of the $\text{Cd}_{0.2}\text{Hg}_{0.8}\text{Te}$ substrate after chemical treatment is equal $R_a = 2.5\text{ nm}$. According to profilography of $\text{Cd}_{0.2}\text{Hg}_{0.8}\text{Te}$ crystals, the surface roughness after CDP with $\text{K}_2\text{Cr}_2\text{O}_7 + \text{HBr} + \text{EG}$ solutions rms is equal to 4.3 nm . It is worth noting that, according to requirements for ultrasmooth polished semiconductor surfaces, R_a could not be higher than 10 nm [20].

Table 1. Apparent activation energy (E_a) and the preexponential factor ($\ln C_E$) of the semiconductor dissolution process in a polishing solution containing (vol. %): 35 $K_2Cr_2O_7$ + 50 HBr + 15 EG

Semiconductor	E_a , kJ·mol ⁻¹	$\ln C_E$	Mechanism of dissolution
CdTe	24.35	11.4	diffusion
$Zn_{0.04}Cd_{0.96}Te$	25.44	11.8	diffusion
$Zn_{0.1}Cd_{0.9}Te$	24.72	11.6	diffusion
$Cd_{0.2}Hg_{0.8}Te$	24.62	11.3	diffusion

It was established for obtaining a high-quality polished surface of researched materials, the chemical-dynamic polishing should be done in etchants containing (vol. %): (25–45) $K_2Cr_2O_7$:(55–75) HBr:(0–30) $C_2H_6O_2$ in the temperature range of 293–296 K at the speed of disc rotation $\gamma = 82 \text{ min}^{-1}$. At the end of the etching process, the samples must be immediately washed with water solution of $Na_2S_2O_3$ to remove unreacted residues of the etchant from the surface (reaction 2) and then a large amount of distilled water.



Developed new slow polishing etchants are of particular interest because they do not contain extremely toxic and unstable bromine, but are bromine-emerging. Putting in the etchant composition EG as viscous component, we can partially regulate the interaction of HBr and $K_2Cr_2O_7$, which contributes to the dissolution of the toxic Br_2 that is released, thus promoting the better dissolution of interaction products of etchants with semiconductors. This makes it possible to change the rate of removal of surface layers of the CdTe, $Zn_xCd_{1-x}Te$ and $Cd_xHg_{1-x}Te$ single crystals, which is important for the etching of thin films. Such etchants act more gently, uniformly and evenly both during removal of the broken layer and during the finishing of the CDP. Storing of polishing solutions even during a rather long time after preparation (up to 180 h) does not affect their polishing properties.

The obtained experimental results allowed to determine the composition of etchants for the formation of polished surfaces of the studied single crystals and to significantly improve the processes of the chemical etching of their surface while developing the working elements for various

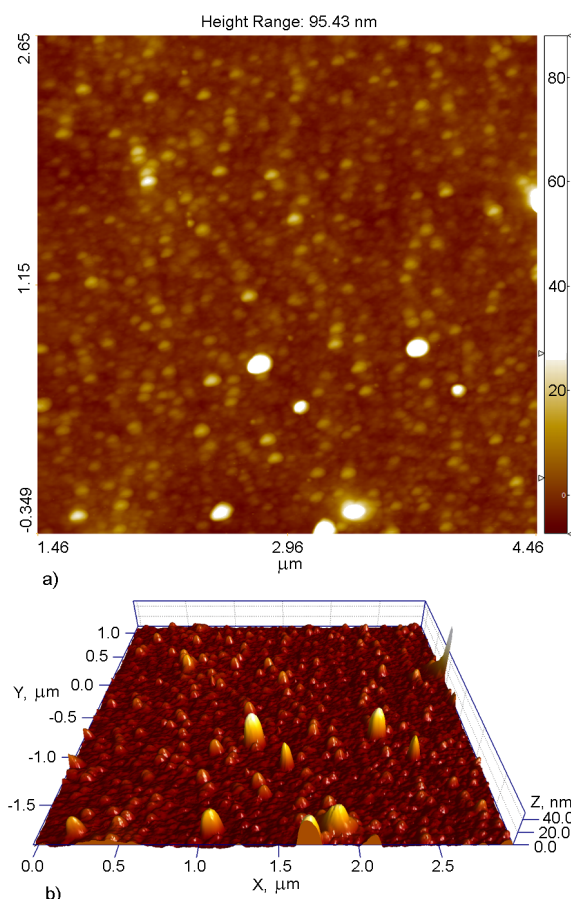


Fig. 6. AFM-images of $Cd_{0.2}Hg_{0.8}Te$ surface received after chemical-dynamic polishing with (in vol. %): 35 $K_2Cr_2O_7$ + 50 HBr + 15 ethylene glycol solution composition.

devices. The sequence of surface treatment for single crystals CdTe, $Zn_xCd_{1-x}Te$ and $Cd_{1-x}Hg_xTe$ is presented in the technological scheme (Table 2). It has been established that after finishing CDP, polished plates can be stored in organic solvent for several weeks. The results of metallographic and profilometric analyzes of samples surface after etching showed the promise of the developed etching compositions for the CDP single crystals CdTe, $Zn_xCd_{1-x}Te$ and $Cd_{1-x}Hg_xTe$ ($R_a \leq 10 \text{ nm}$).

4. Conclusions

The chemical interaction of CdTe and $Zn_xCd_{1-x}Te$ and $Cd_{1-x}Hg_xTe$ single crystals solid solutions with the etching compositions of $K_2Cr_2O_7$ –HBr–EG in the concentration range (vol. %): (20–50) $K_2Cr_2O_7$:(20–80) HBr:(0–60) EG has been investigated. Diagrams "etchant concentration — etching rate" for these semiconductors have been charted, the concentration limits of the pol-

Table 2. Technological scheme of CdTe and solid solutions $Zn_xCd_{1-x}Te$ and $Cd_xHg_{1-x}Te$ processing

1. Cutting of crystals Cut with a diamond spray string (obtaining samples of required sizes)
↓
2. Grinding the surface Aqueous suspensions of abrasive powders M-10, M-5 and M-1 ($\tau = 3-5$ min)
↓
3. Mechanical polishing of plates Diamond paste ASM 7/5, Diamond paste ASM 7/5, ASM 3/2, ASM 1/0 ($\tau = 3-5$ min) (obtaining a smooth polished surface)
↓
4. Inter-operative cleaning washing (H_2O dist. + surfactant) → washing (H_2O dist.) → degreasing (acetone, C_2H_5OH) → drying (dry air flow)
↓
5. Chemical etching to remove the damaged layer Universal etchant 10–15 wt. % I_2 in CH_3OH , at $v = 8-12 \mu m \cdot min^{-1}$, $\tau = 10$ min (removal of damaged layer in the thickness of 80–100 μm before the final CDP)
↓
6. Finishing chemical-dynamic polishing CDP of the surface by new slow polishing etchants, at $v_{pol} = 1.7-8.0 \mu m \cdot min^{-1}$, $\tau = 3-5$ min (polished surface with the required microstructure and roughness)
↓
7. Finishing cleaning 30 sec with 0.1 M $Na_2S_2O_3$ → 1 min with H_2O → 2 min with H_2O → 1 min with H_2O (at $T = 295$ K) → drying by dry air (obtaining a polished surface for contacting)

ishing solutions have been determined and the dissolution of the mention above single crystals has been shown to be limited by the diffusion stages. It was established that the addition of the viscous component — ethylene glycol — to the etching compositions leads to the formation of slow polishing etchants with small ($1.7-8.0 \mu m \cdot min^{-1}$) etching rates. The technique and modes of the CDP of semiconductor surfaces, operations of effective washing of polished surface after etching and prolonged storage of polished plates have been developed. Optimized composition of etchants can be recommended for controlled reducing of single crystals thickness to the specified size, layer etching, chemical etching of thin films and finishing polishing of the surface of CdTe and $Zn_xCd_{1-x}Te$ and $Cd_{1-x}Hg_xTe$ single crystals solid solutions.

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