Polishing Properties of the KIO_3–KI–Organic Acid Etchants to the CdTe and $Zn_{1-x}Cd_xTe$ Surfaces

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Our previous research has revealed that solution, containing potassium iodate (KIO_3) and potassium iodide (KI) in acidic medium find out polishing properties concerning CdTe and $Zn_xCd_{1-x}Te$ surfaces. As an acid agent, aqua solutions of citric and lactic acids were used. In this study to KIO_3–KI etching system an aqueous solution of 2, 3-dihydroxybutanedioic (tartaric) acid ($C_4H_6O_6$) was added. Tartaric acid has higher acidity value (pK_{a1} = 2.89) in comparison with citric and lactic acids. Besides, there are two carboxyl groups in $C_4H_6O_6$ molecule and the tartrate-anion is bidentate complexing ligand. The use of tartaric acid in etching solution can result in a binding of poorly soluble interaction products in stable complexes. The complexation will intensify removal of interaction products from semiconductor crystals and this enable us to obtain high-quality clean surface without sediment and films.

Samples under investigation were cut from CdTe and $Zn_{0.04}Cd_{0.96}Te$ single-crystals. The 5 % KIO_3, 55 % KI and 25 % $C_4H_6O_6$ aqueous solutions were used as mother solutions for the etchant preparation. The etched surfaces microstructure was observed on the Leitz/Laborlux 12HL optical microscope. The surface roughness measuring was carried out on noncontact 3D surface profiler "New view 5022 S". Mathematical simulation of experimental data using the simplex-method was applied and etchant compositions optimization for polishing treatment of CdTe and $Zn_xCd_{1-x}Te$ surface was carried out.

The semiconductor dissolution rate in KIO_3–KI–$C_4H_6O_6$ etching solutions was found to vary from 0.3 μm/min to 6.5 μm/min for CdTe and from 0.3 μm/min to 8 μm/min for $Cd_{0,96}Zn_{0,04}Te$. Thus the studied etching composition can be attributed to the category of slow etchants the same as citric and lactic acids containing KIO_3–KI etching composition. The maximum of dissolution rate of all samples in studied concentration regions was observed in solutions enriched by potassium iodate and potassium iodide simultaneously.

Microscopic and profilographic studies show high-quality polishing properties of the developed etching compositions. It was revealed that etched semiconductor surfaces are smooth, clean and whatever visible films free.

The dependence of the etching rate versus time of solution storage was studied. It was found that KIO_3–KI–$C_4H_6O_6$ etching system can be characterized as age high-resistance. The polishing properties of etchants did not disappear over a period of solution storage. On the ground of obtained results it is possible to draw conclusion that the studied etchant compositions can be used for the controlled removal of the semiconductor materials and polishing treatment of CdTe and $Zn_xCd_{1-x}Te$ surface.