

## Nanostructured surfaces

### Nanosized relief formation of the InAs, GaAs, InSb, GaSb crystals surface

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In the planar technology all elements of the semiconductor devices are created in the substrate surface. That is why the quality and the state of the surface are important. The chemical etching is a popular method of the cleaning and the texturing of the substrates surface. Bromine emerging etchants are one of the most effective polishing solutions. The preliminary researches of the InAs, GaAs, InSb, GaSb chemical-dynamic polishing (CDP) were carried out. It was shown that the  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7\text{-HBr-ethylene glycol (EG)}$  etchants are characterized by low etching rates ( $\mu\text{m}/\text{min}$ ): InAs – 1.7; GaAs – 1.5; InSb – 2.1; GaSb – 1.6.

The chemical-mechanical polishing (CMP) improves the substrate flatness. To clean the semiconductor surface and to achieve the nanosized relief, the CMP was studied using the  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7\text{-HBr-EG}$  etchants. InAs (001), GaAs (111), InSb (112), GaSb (112) crystals were used for the investigations. The single-crystalline ingots were cut into 25 mm<sup>2</sup> size substrates using the string cutting with diamond coating. In order to achieve the nanosized relief, the samples were treated in the following sequence: mechanical grinding, CMP and in-process washing (after each stage of the treatment).

The abrasive powders were used for the mechanical grinding. The damages of the crystal structure are minimized when the abrasive grain size decreases during polishing process. The thickness of the removed layer was ca. 150  $\mu\text{m}$ . The samples were washed in the surfactants solution and distilled water after the mechanical grinding. CMP was carried out using glass polisher which was covered with the batiste cloth. The basic solution was prepared using next reagents (in. vol. %): 11 $(\text{NH}_4)_2\text{Cr}_2\text{O}_7\text{-49HBr-40EG}$ . The solution was kept for 2 h and then additionally the certain amount of EG was added. The substrates were polished with feed rate of the etchant of 3 ml/min during 2-3 min. The mechanical influence significantly increases the etching rate. The polishing surface quality is not changes and the etching rate decreases to 0.8-1.3  $\mu\text{m}/\text{min}$  when the EG concentration is increasing to 95 % in the basic solution.

The surface, obtained after chemical-mechanical polishing, was mirror-like, smooth and without the microcracks. The surface roughness ( $R_a$ ) is: InAs – 0.2 nm, GaAs – 0.1 nm, InSb – 0.3 nm, GaSb – 0.4 nm. The experimental results show that CMP of the InAs, GaAs, InSb, GaSb semiconductors using  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7\text{-HBr-EG}$  solutions forms the nanosized level of the crystals surface.