X-RAY REFLECTOMETRIC INVESTIGATION OF SURFACE ROUGHNES OF SiC SUBSTRATE WAFERS AND ITS INFLUENCE ON THE STRUCTURAL PERFECTION OF THE DEPOSITED SiC EPITAXIAL LAYERS

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The technology of modern high temperature electronic materials often includes the epitaxial deposition of SiC layers on the SiC substrates. The essential for the application is achieving high perfection of the deposited layers, especially elimination of the micro-pipes and basal plane dislocations. The last ones are very dangerous in the high-voltage devices in view of possible migration associated by the formation of the large stacking faults.

Obtaining of highly perfect epitaxial layers is even more conditioned by the appropriate finishing of the surface, than by the concentration of the defects in the substrate crystal, although obviously the last factor cannot be to any extent neglected. It should be also noted that the important influence on the epitaxial growth is also affected by the high temperature etching in the mixture of hydrogen and gaseous propane.

In the present case the important tool of controlling the state of the surface was the specular X-ray reflectometric method supported by fitting of the theoretical reflectometric curves. The perfection of the epitaxial layers and the substrate wafers was also controlled by synchrotron X-ray diffraction topography realized both in the white and monochromatic beam at HASYLAB.

The present X-ray reflectometric investigations were performed for a number of samples both of 4H and 6H polytypes prepared at ITME using various finishing regimes. The investigations confirmed a very good quality of the surface finishing with the processes actually developed at ITME providing in case of 4H wafers the surface roughness $\sigma = 0.55 \pm 0.07$ nm, improved after the high temperature initial etching to $\sigma = 0.22 \pm 0.005$ nm. These values were better than in case of substrate wafers offered by many commercial producers. A relatively good structural quality was confirmed in the case of 4H epitaxial wafers deposited on the wafers prepared from the best ITME crystals with the 8º off-cut.

The synchrotron topographic investigation indicated on the other hand many cases when the not perfect surface finishing lead to the formation of defects and strains in the deposited epitaxial layers. That concerns especially to the phenomenon of step bunging. Also in many other cases we observed a characteristic „grain like" contrast and broadening of the reflection curves of the epitaxial layers deposited on the layers with the irregular surface relief.