Nanocomposites and nanomaterials

Mechanism for the development of anisotropic grain boundary character distribution during nanosilicon film growth

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Nanosilicon thin films have recently attracted considerable attention in the optoelectronics industry owing to their useful electronic and optical features. And it has been revealed that these properties are critically determined by films structures. Of particular importance are such structure elements as grain boundaries and grain boundary joints.

In this work the mechanism for the development of anisotropic grain boundary character distribution during undoped nanosilicon film growth have been studied by transmission electron microscope and atomic force microscope.

Nanosilicon films were prepared by low-pressure chemical vapour deposition on thermally oxidized (100) single-crystal silicon wafers. The deposition temperature was equal to 630^0C. The film thickness was ranged from 3 to 100 nm.

As was shown earlier [2], at film thickness increases up to ~ 70 nm films structure changes from equiaxial to fibrous. Grain boundaries in both equiaxed and fibrous nanocrystalline films were classified as growing in area or shrinking in area on the basis of topology and curvature considerations [3]. Measurements of dihedral angles at grain boundary grooves were used to determine that the energies of growing boundaries are, on average, lower than the energies of the shrinking boundaries. The findings suggest that anisotropic grain boundary character distributions, develop because higher-energy grain boundaries are preferentially eliminated from the network during grain growth.

1. *Nakhodkin, N.G., Rodionova T.V.* Formation of different types of polysilicon film structures and their grain growth under annealing // Phys. Status Solidi A.-1991.-123, N 2.-P. 431-439.

2. *Dillon S.J., Rohrer G.S,* Mechanism for the development of anisotropic grain boundary character distribution during normal grain growth // Acta Materialia.-2009.- **57**.-P. 1-7.