INTERNATIONAL UNION OF MATERIALS RESEARCH SOCIETIES

The Fifth IUMRS International Conference on Advanced Materials

IUMRS-ICAM'99

ABSTRACTS

(2)

Beijing, China
June 13- June 18, 1999

Organized By
C-MRS
Chinese Materials Research Society

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GETTERING OF CU BY MICROCAVITIES IN HELIUM AND HYDROGEN IMPLANTED SILICON-ON-INSULATOR (SOI)

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Microcavities formed by H^+ and He^+ implantation and subsequent annealing are effective gettering sites for transition metal impurities in silicon. However, gettering in SOI materials is quite different from that in silicon because SOI contains a buried oxide (BOX) layer between the overlying silicon layer and silicon substrate. In this study, the formation of cavities in Si wafers using H^+ and He^+ implantation is investigated by cross-sectional transmission electron microscopy. The gettering of Cu to the microcavities in Si, SIMOX (separation by implantation of oxygen) and ion-cut bonded SOI wafers is measured by secondary ion mass spectrometry. Cu is implanted into the surface region of the Si and SOI samples, followed by annealing at 700°C and 1000°C for 2 hours. It is found that although both H^+ and He^+ implantation can produce microcavities at the projected range after annealing at 700°C or above, the density and population of the microcavities are quite different. He^+ implantation in the high dose regime (0.2 to $2\times10^{17}\,cm^{-2}$) creates a wide band of microcavities near the projected range without delamination. On the other hand, the implantation dose of H^+ needed for microcavity formation is relatively narrow (3 to $4\times10^{16}\,cm^{-2}$) and this value is to some extent related to the projected range. In our experiments, H^+ implantation at a dose of $4.5\times10^{16}\,cm^{-2}$ causes blistering on the sample surface. Our results also indicate that these microcavities can effectively getter a high dose of Cu ($2.5\times10^{15}\,cm^{-2}$) at 700°C in Si wafer, but higher temperature annealing is needed for the effective gettering in SOI wafers. It is demonstrated that upon annealing at 1000°C, Cu in the top silicon layer of SOI can diffuse through the BOX layer into the silicon substrate and be trapped by the microcavities beneath. Gettering of Cu by the intrinsic defects at or beneath the BOX interface of the SIMOX wafers is observed at 700°C, but no trapped impurities are observed after 1000°C annealing in the samples in the presence of microcavities. It indicates that the gettering effects of microcavities are stronger than those provided by the intrinsic gettering sites in SIMOX wafers.

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STUDY ON NANO-LAYERED Fe/Cu LAMINATES PREPARED BY EB-PVD

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In recent years, laminate materials have received considerable attention because of their outstanding high strength and hardness. The ability of thin layers to support such high residual stresses and remain coherent suggest that we can produce stacks of coherent layers that can bear high stress without decohesion. In general, resistance to dislocation motion which is one of the keys to material strengthening is greater at smaller layer thickness. Even though it has been reported up to now that tensile strength and hardness can be increased by two or three times in many laminate systems such as Cu-Ni , Al-Cu and the like, the systematic investigations of mechanical properties are failed to be carried out in the range of nano-layered laminates because of their difficulty in measurement. It is expected that this kind of laminate material would have the potentiality of more excellent mechanical properties.

Nano-layered Fe/Cu laminates were prepared by EB-PVD successfully in this study. With the rotation of the basement and the density of electronic current changed, not only specimens of a different layer thickness ranged from 7 nm to 112nm in a fixed content ration of iron and copper, but also ones of varied content ration can be obtained at a layer thickness of 20 nm. Material Test System (MTS) was used for the tensile strength measurements as well as the strain-stress curve. The relationship between the layer thickness and the tensile stress showed that the maximum tensile stress decreased respectively with the increase in the layer thickness or the temperature of the substrate. At a layer thickness of 20nm, the tensile stress exhibited a value that is three times greater than that of pure iron or copper. In addition, fracture morphologies of the surfaces of tensile specimens showed microscopic ductility in failure at high basement's temperature and demonstrated more brittleness at lower one.

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