Ripple Structure of Ion Beam Induced Si Wafers

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Ion beam induced ripple formation in Si wafers was studied by atomic force microscopy (AFM) and non-destructive depth-resolved x-ray grazing incidence diffraction (GID). The formation of a ripple structure at high doses ($7x10^{17}$ ions/cm^2), starting from initiation at low ion beam doses ($1x10^{17}$ ions/cm^2) is evident from AFM, while that in the buried crystalline region below a partially crystalline top layer is evident from GID. GID reveals that these periodically modulated wave-like buried crystalline features become highly regular and strongly correlated as one increases the Ar ion beam energy from 60 keV to 100 keV. The vertical density profile obtained from the analysis of Vineyard profiles shows that the density in the upper top part of the ripples is decreased to about 25% to 35% of the crystalline density. The partially crystalline top layer found at low doses transforms to a completely amorphous layer for high doses. The top morphology was found to be conformal with the underlying crystalline ripple structure. The inspection of the amorphous scattering shows that the amorphous form factor of the damaged top layer is strongly textured in azimuth and scales with the ion dose.

[1] Hazra S., Chini T.K., Sanyal M.K., Grenzer J., Pietsch U., *Phys.Rev.*, 2004, B**70**, 121307(R).

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