Defect and Microstructure Management in the Synthesis and Processing of SIMOX Wafers

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Ion-beam synthesis (separation by implantation of oxygen- SIMOX) can produce $Si:SiO_2$ heterostructures ranging from a layer thickness below 0.1μm to ~0.5μm. In principle, all that must be adjusted in the process is the ion energy and fluence. However, there are unique problems associated (in practice) with forming the $Si:SiO_2$ heterostructure depending upon the thickness of the buried oxide (BOX). The standard (~0.5μm BOX) process is expensive and suffers due to a high density of defects in the superficial Si layer. Alternatively, the thin-film process has difficulty in yielding a continuous BOX below a thickness of 0.1μm. Techniques for overcoming these material problems will be discussed for both standard and thin-film processes. These techniques involve a defect-engineering approach for manipulation of the residual defects and the defect-induced microstructure to achieve the desired material property. Additionally, the $Si:SiO_2$ heterostructure provides some interesting processing advantages over bulk Si for fabricating high-density, integrated circuits. In particular, it will be demonstrated how the buried $Si:SiO_2$ interface can be utilized to form a shallow p^+-n junction by controlling the transient thermal diffusion of implanted boron.

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