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(54) **INTEGRATION OF MONOCRYSTALLINE OXIDE DEVICES WITH FULLY DEPLETED CMOS ON NON-SILICON SUBSTRATES**

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(56) **References Cited**

U.S. PATENT DOCUMENTS

6,326,285	B1		12/2001	Behfar et al.
6,328,796	B1		12/2001	Kub et al.
6,344,404	B1		2/2002	Cheung et al.
6,352,909	B1	*	3/2002	Usenko 438/458
6,355,541	B1		3/2002	Holland et al.
6,387,829	B1		5/2002	Usenko et al.
6,426,248	B2	*	7/2002	Francis et al. 438/197
6,489,241	B1	*	12/2002	Thilderkvist et al. 438/689
6,562,720	B2	*	5/2003	Thilderkvist et al. 438/695
2002/0022344	A1		2/2002	Kang et al.
2002/0053318	A1		5/2002	Levy et al.
2002/0056519	A1		5/2002	Henley et al.

* cited by examiner

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(57) **ABSTRACT**

High quality epitaxial layers of monocrystalline materials can be grown overlying monocrystalline substrates such as large silicon wafers by forming a compliant substrate for growing the monocrystalline layers. An accommodating buffer layer comprises a layer of monocrystalline oxide spaced apart from a silicon wafer by an amorphous interface layer of silicon oxide. The amorphous interface layer dissipates strain and permits the growth of a high quality monocrystalline oxide accommodating buffer layer. Any lattice mismatch between the accommodating buffer layer and the underlying silicon substrate is taken care of by the amorphous interface layer. In addition, formation of a compliant substrate may include utilizing surfactant enhanced epitaxy and epitaxial growth of single crystal silicon onto single crystal oxide materials. Monocrystalline substrates having a hydrogen ion implant are cleaved along the hydrogen ion implant, and an insulating substrate is bonded to the monocrystalline oxide.

17 Claims, 7 Drawing Sheets