Method for Growing Epitaxial STO (110) Films without Any Buffer Layer

Patent Title:	Method for epitaxial growth of (110)-oriented $SrTiO_3$ thin films on silicon without template
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This invention provides a method for growing epitaxial (110)-oriented $SrTiO_3$ thin films on silicon without any buffer layer, by pulsed laser deposition (PLD) technique. The thin films produced are suitable for various applications such as perovskite oxide devices and high-k dielectric constant capacitor materials.

Market Opportunity

The (110) oriented $SrTiO_3$ (STO) structure is useful for practical applications such as the preparation of ferroelectricinsulator-semiconductor devices. According to Yole Development's Technology & Market report, the Compound Annual Growth Rate (CAGR) of the global ferroelectric thin films market is higher than 7.5% [1]. FeRAM is one of the main driving factors behind this growth. According to another report produced by Innovative Research and Products Inc, the 2010 global market for emerging non-volatile random access memory products was projected to have reached US$ 115 million and this market is expected to increase to US$ 1.6 billion by 2015 at a CAGR of 69%. [2].

The HKU Invention

The system of STO /Si can be used as a growth substrate for the fabrication of thin films of other functional oxides and carbon nanotube transistors. However, it has been a challenge to grow epitaxial STO thin films on Si. Previous research indicates that the use of a single buffer layer or double buffer layer is necessary to prepare high-quality STO (110) films on Si (100) substrates. Moreover, direct epitaxy of STO on Si is commonly regarded as quite difficult due to the thermodynamic problem of interfaces.

To improve on the previous technology, this invention provides a method for growing STO films with single (110) out of plane orientation upon a silicon surface substrate. Its process makes epitaxial growth simpler and easier to handle. Epitaxial STO (110) films have been produced successfully on Si (100) without any buffer layer by

a) crystallizing an Sr-silicate interfacial layer epitaxially onto the silicon substrate under low oxygen pressure for about 1 to 5 minutes at a temperature of about 760° C; and

b) depositing the SrTi03 film at low oxygen pressure at a temperature of about 760° C.

With this advanced technology, a variety of oxide heterostructures can be fabricated. This invention can be applied to an epitaxial template and barrier for the integration of many other functional oxide

materials on silicon. In particular, the (110)-oriented STO structure is useful for practical device applications as well as for providing a broad range of solutions to the problem of polarity discontinuities at perovskite heterointerfaces. Such structures will be the key element for making microwave and magnetic devices which are used in a wide variety of commercial applications.

About the Lead Inventor

Prof. Ju Gao received his BSc from Peking University in 1982; he received his MSc from the Chinese Academy of Sciences and worked there until 1987. After completing his PhD study in Twente University of the Netherlands in 1992, he joined the University of Hong Kong. His research interests include ceramics, oxide materials, thin films and functional devices.

References

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