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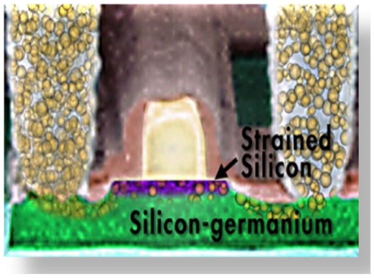
INSIDE THIS ISSUE:

❑ STRAINED SILICON

Aggressive scaling has become the main stimulus to the performance improvement of Si-based CMOS devices over last four decades. But the scaling methodologies are becoming more and more complicated to maintain when the device dimensions enter into the deep submicron regime. Consequently, new materials and innovative device architectures are actively being investigated with a view of boosting up the performance of the device. Strained-Si has been shown to be one of the most promising alternatives because of its CMOS compatibility. The introduction of strained-Si into MOSFET technology has resulted into high performance CMOS devices due to its enhanced mobility, high field velocity and velocity overshoot of carriers. Introduction of strain on channel alters the band gap, electron affinity and various material parameters such as band offsets at the hetero-interface between the strained-Si channel and SiGe virtual substrate which influence the device performance in terms of threshold voltage, drive current, trans-conductance, mobility etc.



So the accurate device characterization techniques and models for design and simulation are essentially required to be developed to improve the underlying physics of the devices which are beginning to adopt present day strained-Si technology.

Si is the material which has dominated the semiconductor industry for over last few decades because Si is the cheapest microelectronic technology for integrated circuits. The most important reason for the dominance of Si is the availability of its two insulators, silicon dioxide and silicon nitride. The chemistry of Si and Si insulators allow deposition on and selective etching processes to be developed with exceptionally high uniformity. By combining these process technologies on ever increasing wafer diameters, integrated circuits may be built up with increasing number of transistors. .

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❑ CONTRIBUTING TOWARDS A GREEN SOCIETY

Earth is always hailed as the Green Planet with its Lustrous greenery, the scenic oceans, the amazing mountains that always struck awe in peoples' mind. Like a mother's womb, the earth provided safety and nourishment to the growing human civilization when it was in its embryonic stage. The Civilization grew, with slow and steady steps, drawing nourishment from the mother earth. With the advent of industries, the growth rose exponentially. Like a grown up man, the civilization lost its link with its mother and ran after money and work. The earth started being neglected. The Human beings forgot about their cocoon of growth and started depleting the natural resources heedlessly. Today, we are faced with insurmountable environmental problems and the fear of extinction looms at large. Going Green is not only the responsibility of the government, but also the citizens'. Even small changes in our lifestyle can help saving the earth. Use of Fluorescent lamps, cutting down on daily water usage, switching off car engines at traffic signals are efficient ways of going green.

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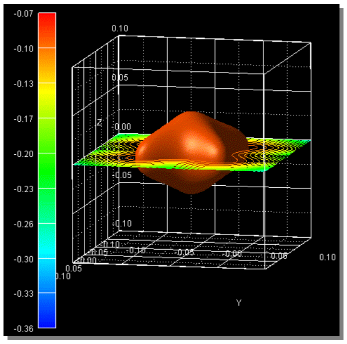
❑ Continued strained silicon

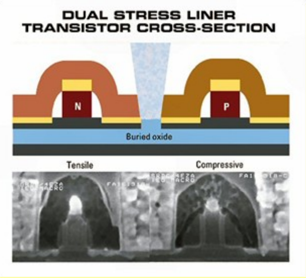
By combining these process technologies on ever increasing wafer diameters, integrated circuits may be built up with increasing number of transistors. By scaling the transistors to smaller dimension, greater numbers can be integrated onto a Si chip. But low mobility, low velocity saturation and indirect band gap of Si have allowed other semiconductor materials to be used in microelectronic industry. So the field has expanded by developing the growth technology. Material compatibility allows the Si/SiGe heterostructure to be integrated into the existing Si technology– both in bipolar and MOS application. The enhanced carrier transport in Si/SiGe heterostructure has led to improved device performance. The 4.2% lattice mismatch between Si and Ge has been exploited in a variety of pseudomorphic Si/SiGe heterostructures. The Si/SiGe modulation doped field effect transistor showing the potential for high speed applications has already been reported with maximum oscillation frequency.So the first major performance booster to conventional CMOS was the introduction of Si/SiGe in the channel region. The active channel material, either Si or SiGe is strained to match the lattice constant to that of the unstrained substrate material, SiGe or Si respectively. In order to continue to drive the performance from Si/SiGe technology, it is necessary to understand the physics behind strain and to develop unified models to effectively predict a device behavior and design them

Strained Silicon Formation

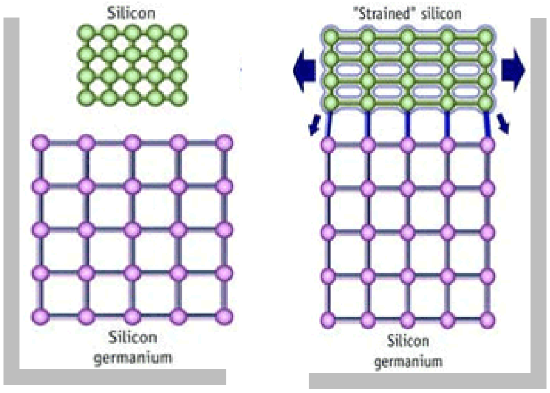


Strain in the thin film lattice can be due to various reasons, including lattice constant differences, inclusion of atoms of impurities in the interstitials, and thermal processing. However, not all strain in the lattice is constructive and beneficial to the device. There are numerous ways to induce strain in the silicon lattice. The key requirement is to make process repeatable, cost effective and compatible with existing manufacturing technology, and able to withstand the thermal cycles. There are various types of strain which can be applied either in one, two or three dimensions, each having its own effect on the physical properties of the material. The two major straining techniques widely studied and used in the industry are biaxial strain and uni-axial strain. Biaxial strain is strain to the lattice in the x-y plane with a negative compressive strain in the z direction. The other type of strain is process. Induced strain or uni-axial strain, where the principal strain lies in one direction and other two directions adjust to match. Figure 2.1. shows, the collective summary of different methods of straining techniques.

Uniaxial stress Generation



Uniaxial stress generation process is a widely adopted process in almost all high performance logic technology devices. In Uniaxial process-induced strain, the strain is added in the channel layer beneath the gate/gate dielectric stack in the (110) plane by introducing a tensile/compressive stressed nitride capping layer on the device structure. A predominant method for depositing an ultra high stress nitride layer is plasma enhanced chemical vapor deposition process along with post deposition treatment at high temperature (~ 650°C) to minimize hydrogen content and maximize stress enhancement. In this process a tensile plasma-enhanced nitride (TPEN) layer is first deposited over the device and then selectively etched over p-MOS leaving a tensile stressed n-MOS, followed by compressive plasma-enhanced nitride layer (CPEN) layer deposition over PMOS. Because these stress lines also act as an etch stops for contact etch this approach is referred to as dual etch stop liners (dESL) . This process is mostly used by IBM and AMD with SOI integration . However, this process has a drawback due to dependence on geometry and gate pitch.



Biaxial Stress Formation

A widely adopted approach to introduce wafer-based stress relies on the fact that the lattice constant of SiGe alloy is slightly larger than pure Si. When a film is pseudomorphically grown or deposited on a substrate, the mismatch strain between the two layers due to difference lattice constant is given by

$$\varepsilon_{strain} = \frac{a_{sub} - a_{film}}{a_{sub}} \qquad \text{……….1}$$

$$\sigma_0 = -2\gamma \frac{\nu + 1}{\nu - 1} \qquad \text{……….2}$$

where a_{sub} and a_{film} are the lattice constants of the substrate and film, respectively. The stress then can finally be computed based on Hooke's law as

where γ is the shear modulus and v is the Poisson ratio.

As there is a 4.2% lattice mismatch between Si and Ge, the strain induced by lattice modifies the band-structure of the SiGe layer and Si layer. Whenever a silicon germanium film is deposited over Si, it is forced to accommodate a film with lower lattice constant; hence the silicon germanium film is under a longitudinal and transverse compressive stress with an out-of-plane tensile component. On other hand, if a Si film is deposited on a SiGe film, a biaxial longitudinal and transverse tensile stressed layer is produced with an out-of-plane compressive component.

BY VEDATRAYEE CHAKRABORTY (TEACHER)

❑ Continued Contribution Towards A Green Society

Going Green is not only the responsibility of the government, but also the citizens'. Even small changes in our lifestyle can help saving the earth. Use of Fluorescent lamps, cutting down on daily water usage, switching off car engines at traffic signals are efficient ways of going green. Turn off appliances when not in use, particularly those that spend most of their time in "standby" mode like computers, printers, and DVD players. A study says "8% of household electricity is wasted by the standby mode on appliances". Keeping the tap off while brushing and bathing in stored water rather than shower can save more than 50 litres of water per person per day. Not opting for ATM receipts and free brochures can save paper. Using solar powered appliances, lights may save energy. Storing rainwater and using them for watering plants, washing cars can also help saving water. Instead of travelling in a personal vehicle, use of a public transport can save fuel. Making sure doors and windows are sealed tightly in the air-conditioned rooms can result in huge energy savings. Cooking in Copper base utensils can save cooking fuels. Use of LPG vehicles is a trend now as they have less emissions and greater mileage. The society is turning towards the use of renewable sources of energy. Wind energy, Geothermal energy, Solar energy are being used as substitute of Thermal Energy. People should recycle metal, glass and paper. Recycling one ton of paper saves 17 trees, 2 barrels of oil, 4,100 kilowatts of energy, 3.2 cubic yards of landfill space and 60 pounds of air pollution. Recycling one aluminum can saves enough electricity to power a TV for three hours, and aluminum cans can be recycled an unlimited number of times. Recycling a ton of glass saves the equivalent to 9 gallons of oil. Increasing steel recycling by 50% would save the energy equivalent to 7 nuclear power plants. These statistics show just how important recycling really is.

Collective and concerted efforts from people from all walks of life can save our planet. Going Green is a responsibility that all individual should take up in order to ensure the safety of their children and make the earth a better place to live in….

BY **ABIR SINHA** ***(3RD YEAR ELECTRONICS AND COMMUNICATION)***

❑ IMAGE GALLERY

COLLEGE CAMPUS

LABORATORIES

COLLEGE FEST TRANCE'08

❑ ABOUT US

In today's society science and technology plays a very important part in every walk of life. Every day the role of technology in our lives are becoming more and more important and with this increases the need for engineers. So it is necessary to setup more and more engineering colleges. But the engineering college setup must have all the necessary provisions required for a student to get proper training in their respective branches. The college should not remain only as a profit making company; instead it should be a place to provide best possible facilities for the students and the best working atmosphere for the staff. So here we propose an institute of technology where all the students will get the best possible facilities in their respective fields.

♦ *CONTACT US*

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♦ Dr. D. Sarkar(college director):

Mr. Dipankar Sarkar is a Doctorate in Electrical Engineering and also involved in the promotion of various colleges for the past 7 years.

♦ ABOUT DREAM

Establishment: 2006

Institution Type: Private College

Recognition: Approved by the All India Council for Technical Education (AICTE), New Delhi;

AICTE Region: Eastern

Here is a partial list of courses offered by the institution:-

1. COMPUTER SCIENCE ENGINEERING(60 SEATS)
2. ELECTRONICS AND COMMUNICATION ENGINEERING(60 SEATS)
3. ELECTRICAL ENGINEERING(60 SEATS)
4. APPLIED ELECTRONIC ENGINEERING(60 SEATS)

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