Sample of Level 2 Editing

Theoretical Study of Electron Mobility for ~~Silicon~~Silicon-Carbon Alloys

Abstract

Electron mobilities in strained $Si_{1-x}C_x$ layers grown on a Si substrate and relaxed alloys are calculated as functions of ~~carbonc~~Carbon content, alloy scattering potential, and doping concentrations at room temperature. The electron mobility model is backed~~justified~~ by experimental data. In the case of doped strained $Si_{1-x}C_x$, the results of our ~~model on~~ electron mobility model indicates that for systems with a doping concentration greater than~~above,~~ $10^{18}cm^{-3}$~~–~~, there is no substantial decrease in the in-plane mobility with an increase in the ~~C~~carbon mole fraction~~as the carbon mole fraction increases~~. However~~,~~,~~In contrast,~~ for low doping concentrations, the mobility decreases~~is strongly reduced~~ with a decrease in the ~~carbonC~~carbon mole fraction~~ for low doping concentrations.~~

Comment [a1]: CHECK: Is this what was meant by this sentence. Could say “The use of the electron mobility model is justified, based on experimental data.’

I. INTRODUCTION

Charge carrier mobility in strained Si and $Si_{1-x}C_x$ layers has attracted increasing

interest in recent years due to ~~the~~ technological progress in heteroepitaxy. Since t~~T~~he lattice constant of $Si_{1-x}C_x$ alloys ~~is~~ are less~~smaller~~ than that of Si, ~~so~~ the strain condition of strained $Si_{1-x}C_x$ on a Si substrate is similar to that of ~~the~~ high mobility strained Si on relaxed SiGe. Thus, the $Si_{1-x}C_x$ channel embedded in Si has been proposed as an alternative to the strained Si channel. Since a graded buffer is ~~not~~ unnecessary for the fabrication of a strained $Si_{1-x}C_x$ layer, ~~high crystalline perfection of~~a ~~–~~$Si_{1-x}C_x$ channel with high crystalline perfection is obtained. High quality pseudomorphic $Si_{1-x}C_x$ layers with up to 7% ~~carbon~~Ccarbon content ~~up to 7%~~ have been~~are~~ reported [1]. This alternative material ~~that~~ produces tensile strained layers~~,~~ and is an attractive option because it eliminates the need to deposit a thick, relaxed SiGe buffer layer. Additionally, the elimination of this relaxed buffer layer allaeys concerns about the ~~propogation~~propagation of~~over a~~ high ~~density of~~ defect densities~~s~~ ($1\times10^{11}cm^{-2}$) ~~propagating~~ to the channel region. Theoretical calculations predict enhanced electron mobility for strained $Si_{1-x}C_x$ alloys [2], [3]. The q~~Q~~uantitative enhancement factor is strongly correlated to the assumed alloy scattering potential for the calculations [2], [3]. The Stanford group [4] has fabricated and demonstrated the operation of the surface channel of strained $Si_{1-x}C_x$ NMOSFET, characterizing the electron inversion mobility both at room temperature and low temperature. However, it appears that the expected strain induced phonon-limited mobility enhancement has

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Consider an example range of these specified temperatures. i.e. Consider stating how low you mean when you mention “low temperature”.

beenappears to be compensated for by the random alloy scattering and coulomb Coulomb scattering associated with non-substitutional carbonCcarbon atoms [4]. Recently, the UT group has demonstrated the buried channel strained $Si_{1-x}C_x$ PMOSFET for the first time. Strained $Si_{1-x}C_x$ PMOSFET fabricated on the $Si_{1-x}C_x$ layer demonstrated showeddemonstrated enhanced hole mobility compared toover that of controlled Si [5]. However, the strained $Si_{1-x}C_x$ surface channel PMOSFET has not yet beenis not yet fabricated and demonstrated in experiments. The LETI group was the first to reportpresent for the first time epitaxially grown $Si_{1-x}C_x$ NMOSFET channels acting boron blocking barriers containing up to 1.4% substitutional carboncCarbon [6]. In this paper, we focus on the electron mobility in strained $Si_{1-x}C_x$ alloys. All electron mobility models for strained $Si_{1-x}C_x$ published so far haveare with limited generality (e.g. they neglecting the influence of CarbonCcarbon on phonon scattering [2], [3]) and have not beenare not verified experimentally by the measurement of mobility in strained $Si_{1-x}C_x$ layers. This paper aims to closeat closing this gap.

We performed a theoretical study ofin the electron mobility in strained $Si_{1-x}C_x$ alloys with a continuous variation in theof carbonCcarbon concentration. The study isthat is useful for future device design and simulation. In Sec. II, we discuss the theoretical models of our work . andThen in Sec. III, we discussdiscusses about our

Comment [a4]: CHECK: Is this the correct interpretation of this sentence?

Comment [a5]: CHECK: The meaning of this phrase is unclear, please rewrite. Do you mean “acting as boron blocking barriers containing up to…”?

results. ~~Summary is given in Sec. IV.~~Sec. IV contains the summary.

II. ~~THEORY~~

~~waswasareof~~