結晶系SiGeナローギャップ材料太陽電池の開発

Narrow-gap crystalline SiGe thin-film solar cells with heterojunctions

結晶シリコンチーム　劉　正新

Advanced Crystalline Si Team / Zhengxin Liu

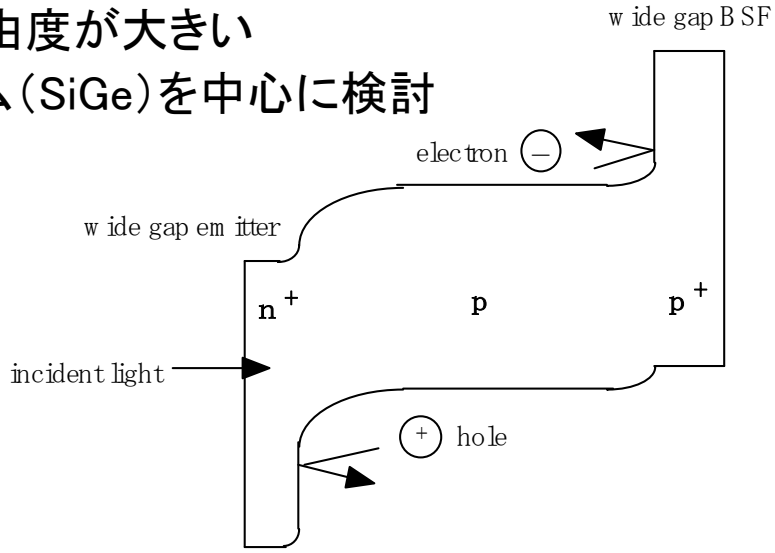
背景と目的

精密制御結晶系ヘテロ接合太陽電池

・単結晶Ge太陽電池では従来ほとんど検討例がない
・分子線ビームエピタキシー（MBE）→組成、歪制御によるヘテロ接合の形成、
　バンドプロファイルの高精度変調　→　設計自由度が大きい
・ナローギャップ材料としてはシリコンゲルマニウム（SiGe）を中心に検討
　バンドギャップ:　0.75～0.9eV

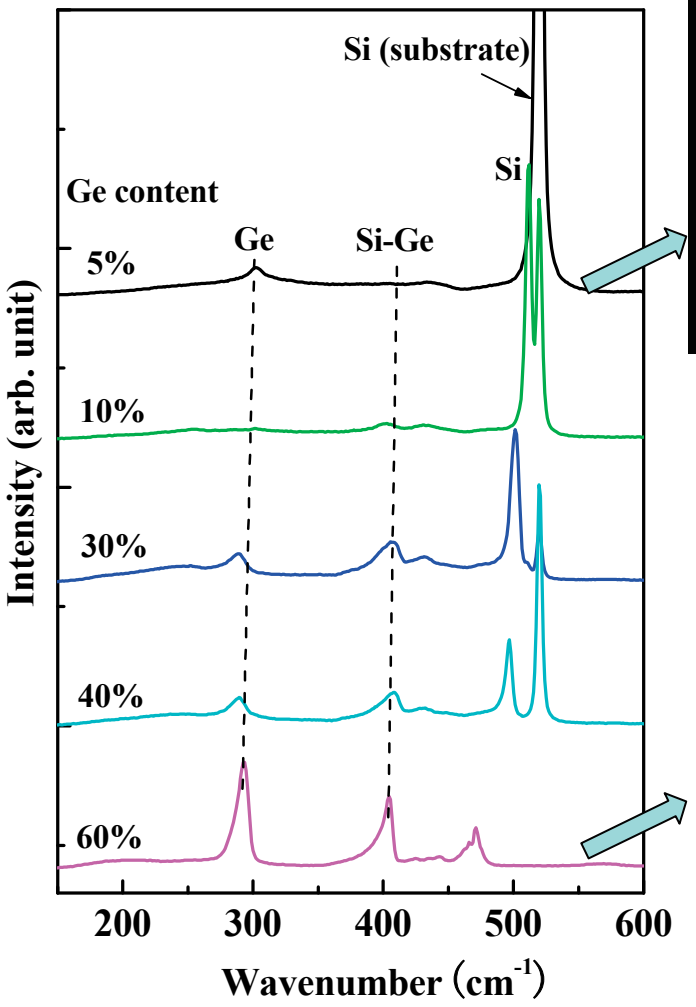
期待される効果:

・接合の組み込み電圧の向上　→　開放電圧向上
・界面再結合速度の低減　→　開放電圧向上
・温度特性の改善
・新しい光起電力過程の可能性検討



Epitaxial growth of SiGe on Si substrate by MBE

Raman spectra of SiGe on Si

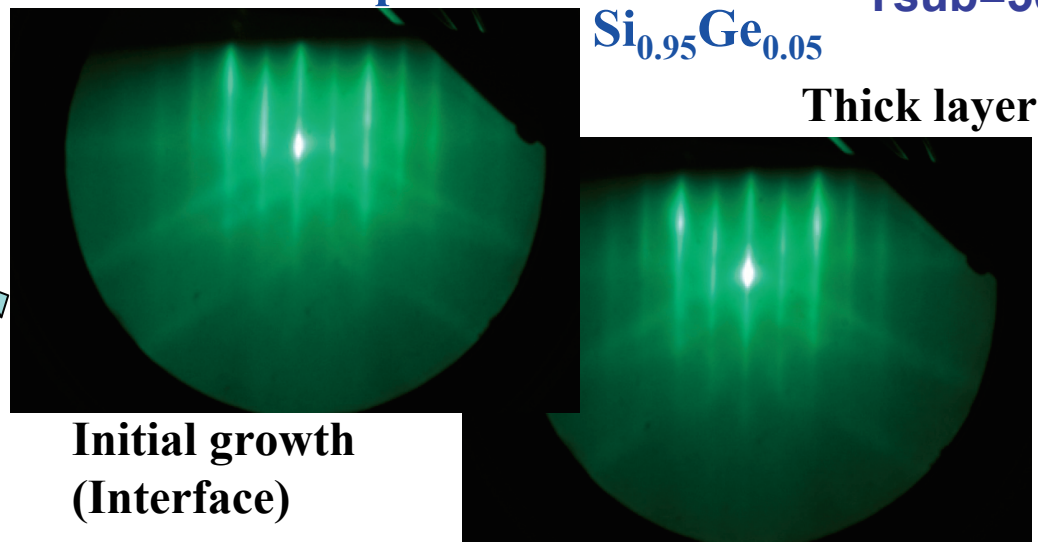


RHEED patterns

Tsub=500C

$Si_{0.95}Ge_{0.05}$

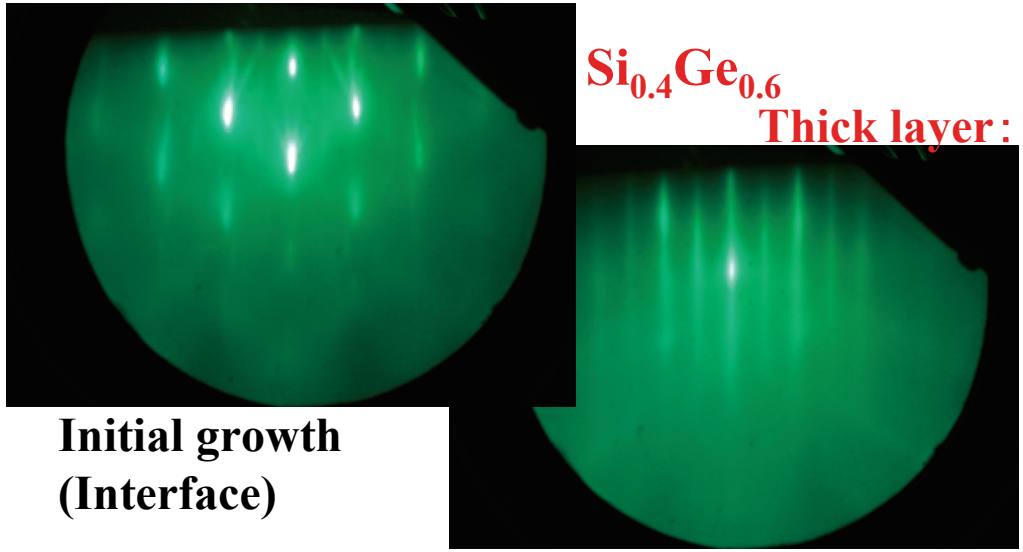
Thick layer



Initial growth
(Interface)

$Si_{0.4}Ge_{0.6}$

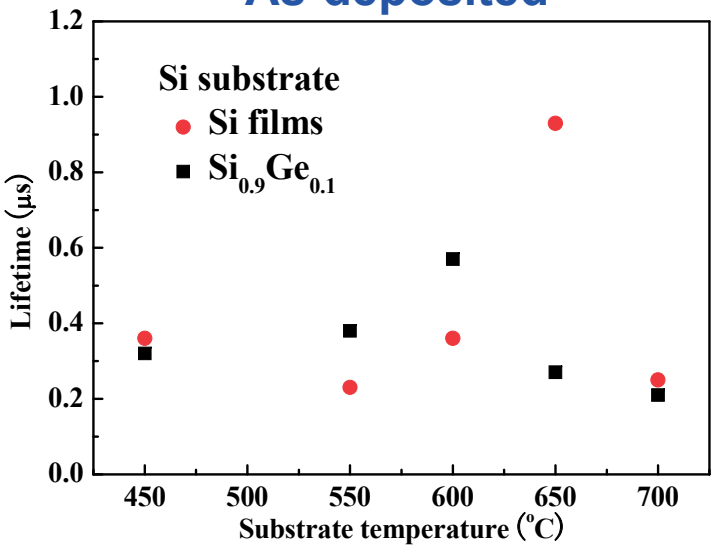
Thick layer: 5μm



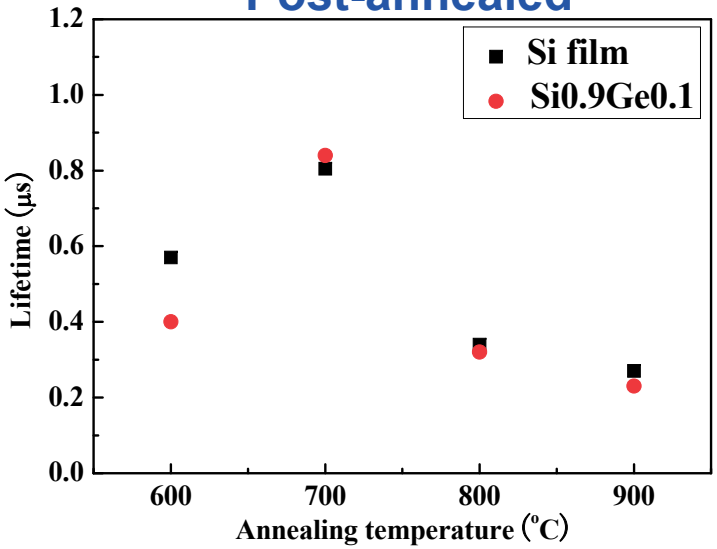
Initial growth
(Interface)

Characterization of carrier lifetime for SiGe films

As-deposited



Post-annealed

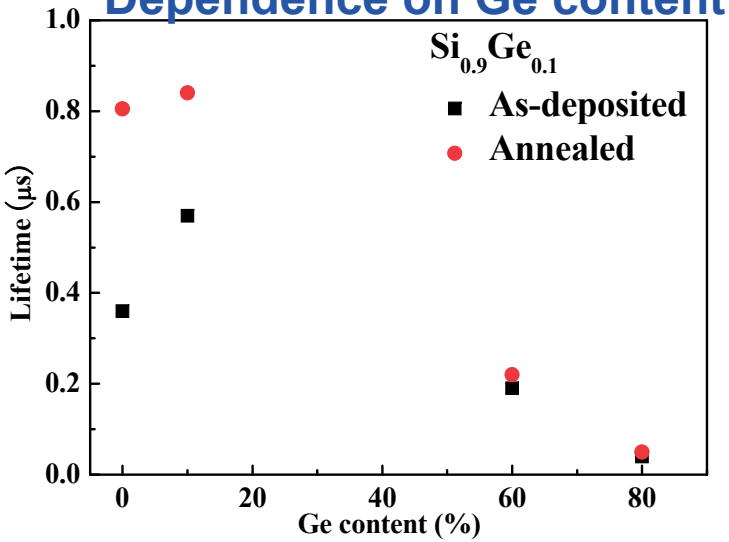


- Sample preparation

SiGe films
Si/Ge substrate
with low resistivity <0.1Ωcm

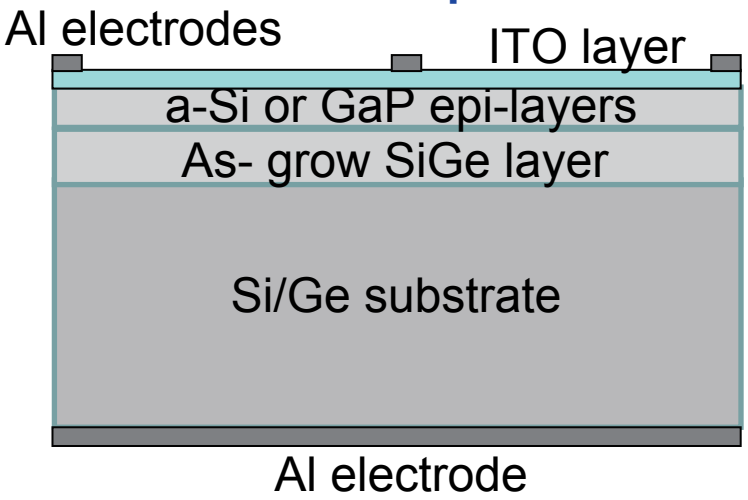
- Surface passivation with 0.01molar quinhydrone in methanol solution
- Measure carrier lifetime with μPCD

Dependence on Ge content

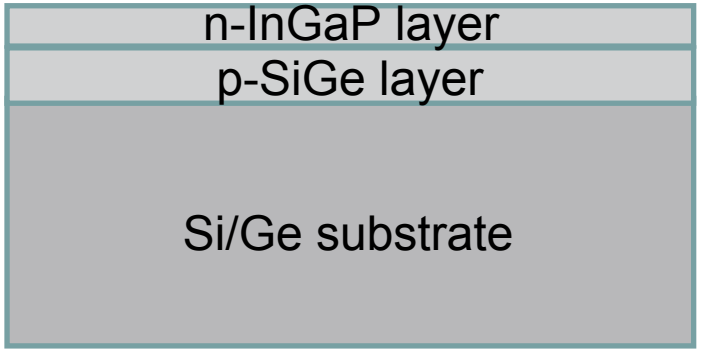


Heterojunction solar cells based on SiGe films

Test samples

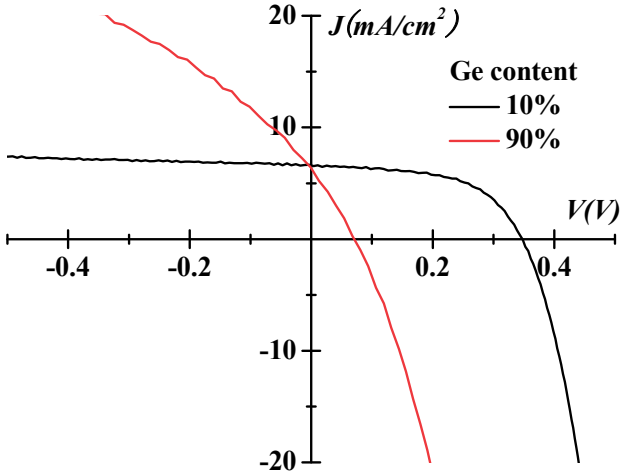


Final goal



ITO/a-Si/SiGe/Si(Ge) solar cells

I-V curves



IQE curves