HW20

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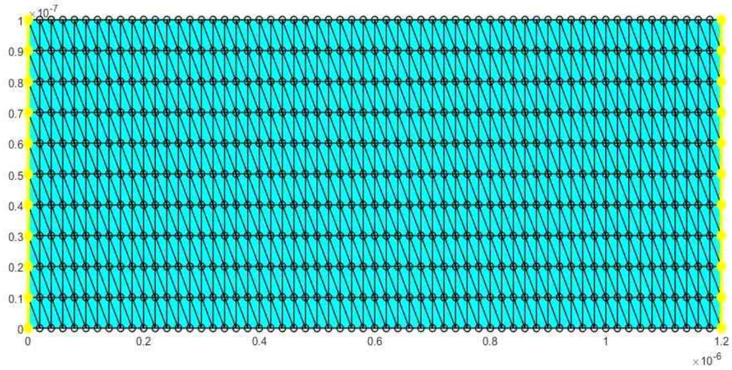
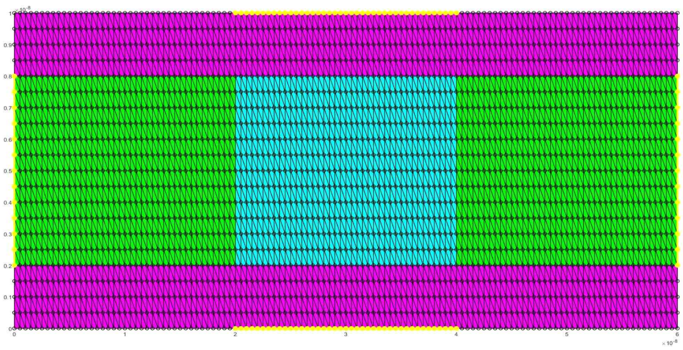
structure

homogeneous sample	profile
	전체 cyan : silicon 좌측 yellow line : source contact 우측 yellow line : drain contact x length : 1200nm y length : 100nm device width : 1μm N-type doping : 2E23($/m^3$) $V_{cathode} = 0V$ $V_{anode} = 0V$

Double gate MOSFET	region & contact
	상단 magenta : gate oxide1 하단 magenta : gate oxide2 좌측 green : source region 우측 green : drain region 중앙 blue : silicon region 상단 yellow line : gate contact1 하단 yellow line : gate contact2 좌측 yellow line : source contact 우측 yellow line : drain contact
gate oxide thickness : 2nm silicon thickness : 6nm source / drain length : 20nm channel length : 20nm total x length : 60nm total y length : 10nm device width : 1μm	N-type doping : 5E26($/m^3$) P-type doping : 2E21($/m^3$) gate workfunction : 4.3eV e mobility : 1417E-4 p mobility : 580E-4

(과제 설명)

기존의 2D homogeneous sample에 green function을 적용한다. 3개의 식, poisson equation, electron continuity, hole continuity equation에 대하여 perturbed 된 case를 나누어 $\vec{r_0}$를 변화시켰을 때 G parameter를 확인해보고 결과를 비교해본다.

perturbed	potential	electron	hole
Poisson equation	$G_{\phi\phi}(\vec{r},\vec{r_0})$	$G_{n\phi}(\vec{r},\vec{r_0})$	$G_{p\phi}(\vec{r},\vec{r_0})$
electron continuity	$G_{\phi n}(\vec{r},\vec{r_0})$	$G_{nn}(\vec{r},\vec{r_0})$	$G_{pn}(\vec{r},\vec{r_0})$
hole continuity	$G_{\phi p}(\vec{r},\vec{r_0})$	$G_{np}(\vec{r},\vec{r_0})$	$G_{pp}(\vec{r},\vec{r_0})$

(equation)

- Poisson equation perturbed

-> $\nabla^2(\epsilon G_{\phi\phi}(\vec{r},\vec{r_0}))+q(G_{p\phi}(\vec{r},\vec{r_0})-G_{n\phi}(\vec{r},\vec{r_0})+N_{dop})=\delta(\vec{r},\vec{r_0})$

- electron continuity perturbed

-> $jwG_{nn}(\vec{r},\vec{r_0})-\frac{1}{q}\nabla\cdot(-q\mu_n G_{nn}(\vec{r},\vec{r_0})\nabla\phi_{DC}-q\mu_n n_{DC}\nabla G_{\phi n}(\vec{r},\vec{r_0})+qD_n\nabla G_{nn}(\vec{r},\vec{r_0}))=\delta(\vec{r},\vec{r_0})$

- hole continuity perturbed

-> $jwG_{pp}(\vec{r},\vec{r_0})+\frac{1}{q}\nabla\cdot(-q\mu_p G_{pp}(\vec{r},\vec{r_0})\nabla\phi_{DC}-q\mu_p p_{DC}\nabla G_{\phi p}(\vec{r},\vec{r_0})-qD_p\nabla G_{pp}(\vec{r},\vec{r_0}))=\delta(\vec{r}-\vec{r_0})$

- $\vec{r_0}$ change, $x=\vec{r_0}$에서 residue=1

Homogeneous sample

기존	**solution matrix** = $\begin{pmatrix}\textbf{A matrix}\end{pmatrix}$ X $\begin{pmatrix}\textbf{b matrix}\end{pmatrix}$
수정	**solution matrix** = $\begin{pmatrix}\textbf{A matrix}\end{pmatrix}$ X $\begin{pmatrix}\textbf{identity matrix}\end{pmatrix}$

solution matrix의 우변의 b matrix를 boundary condition을 적용한 identity matrix를 사용하여 모든 node에서의 perturbed 한 case를 비교해보았다. 각 열은 어떤 equation이 perturbed 되었는지를 나타내며, 해당 equation이 perturbed 되었을 때, 행은 parameter를 나타낸다.

3i-2 열 : Poisson equation perturbed

- 3i-2행 : $G_{\phi\phi}(\vec{r},\vec{r_0})$
- 3i-1행 : $G_{n\phi}(\vec{r},\vec{r_0})$
- 3i행 : $G_{p\phi}(\vec{r},\vec{r_0})$

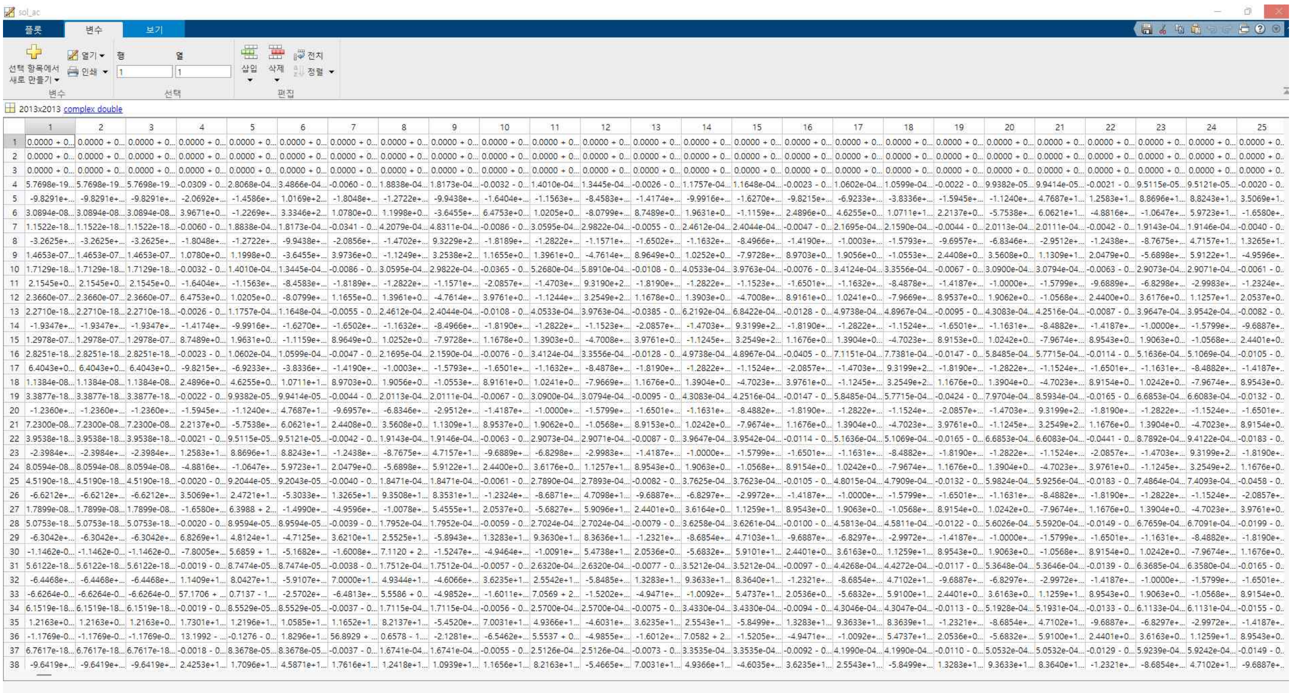
3i-1 열 : electron continuity equation perturbed

- 3i-2행 : $G_{\phi n}(\vec{r},\vec{r_0})$
- 3i-1행 : $G_{nn}(\vec{r},\vec{r_0})$
- 3i행 : $G_{pn}(\vec{r},\vec{r_0})$

3i 열 : hole continuity equation perturbed

- 3i-2행 : $G_{\phi p}(\vec{r},\vec{r_0})$
- 3i-1행 : $G_{np}(\vec{r},\vec{r_0})$
- 3i행 : $G_{pp}(\vec{r},\vec{r_0})$

Homogeneous sample result



Double gate MOSFET

double gate MOSFET의 경우 transient simulation과 small signal simulation에서의 admittance를 구했을 때, 유의미한 오차가 존재하여 현재 code 수정 중에 있습니다.