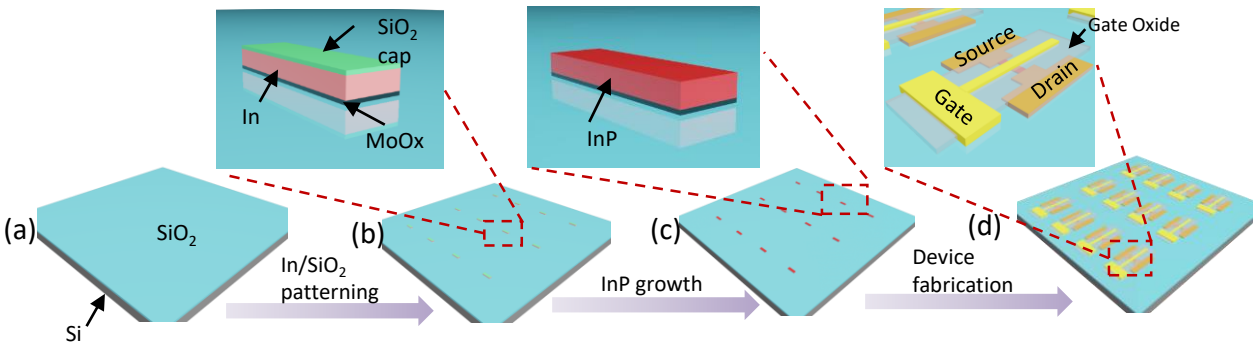
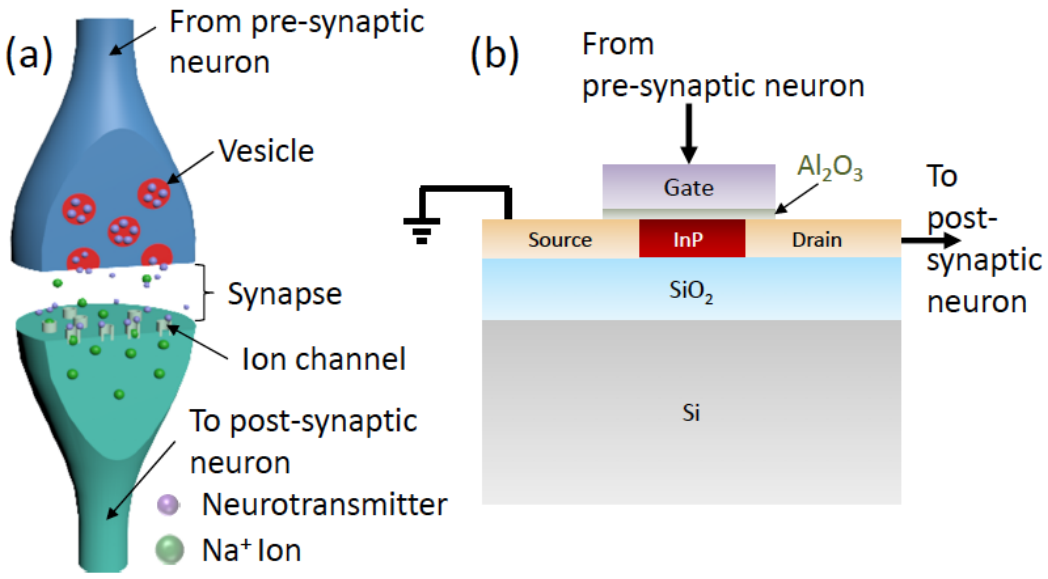
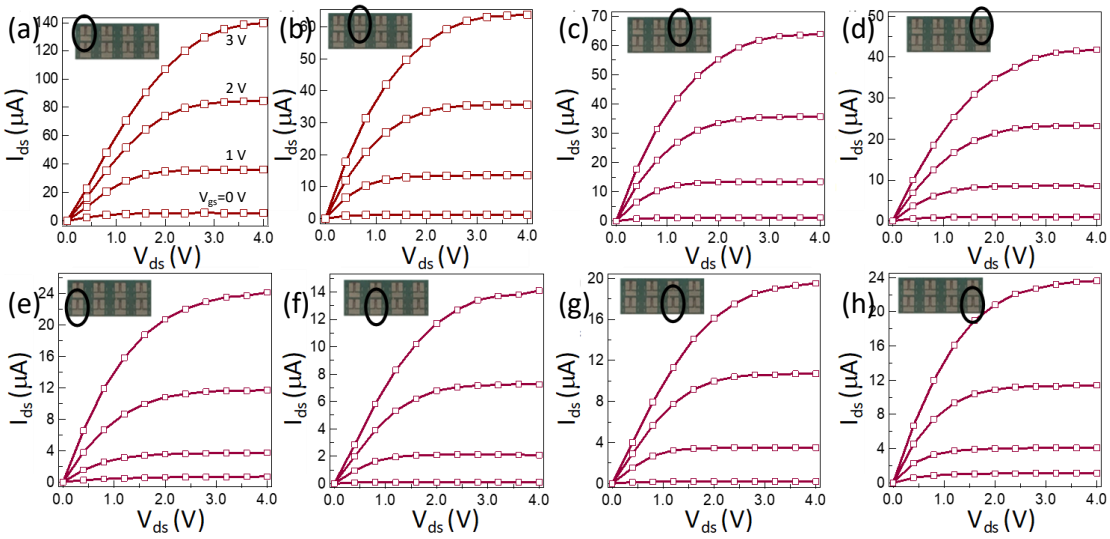
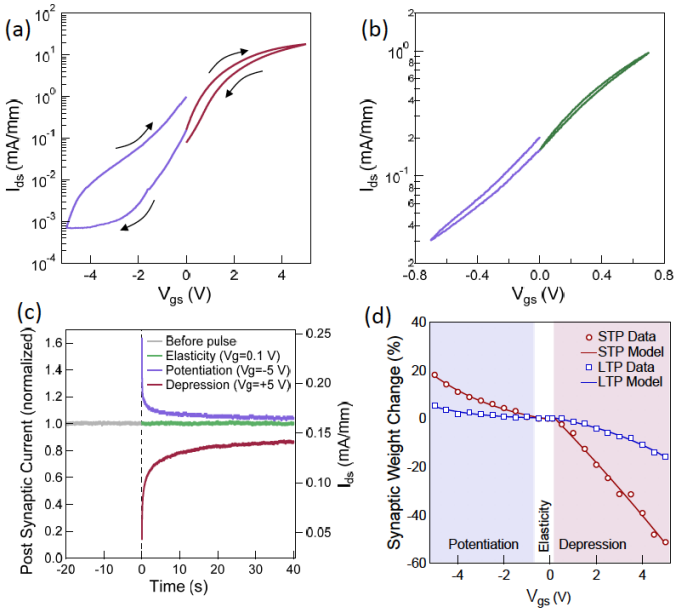
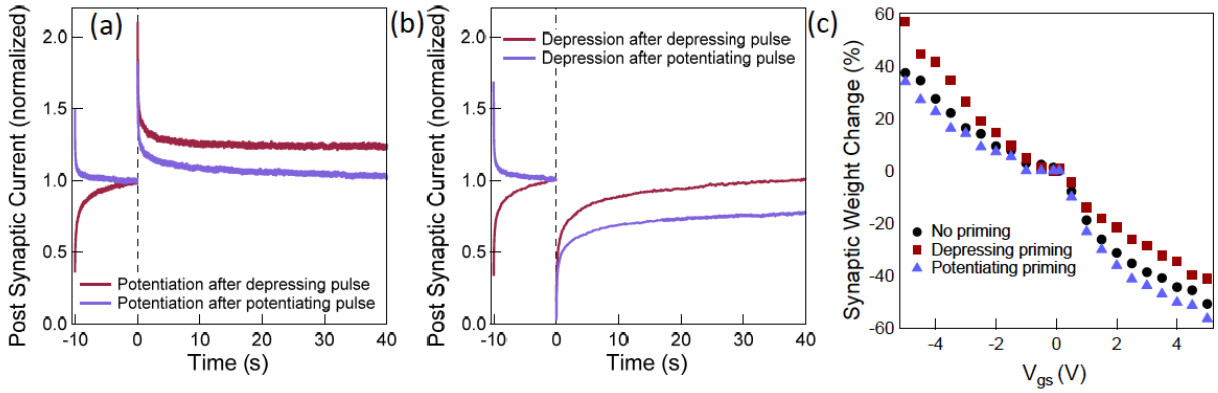
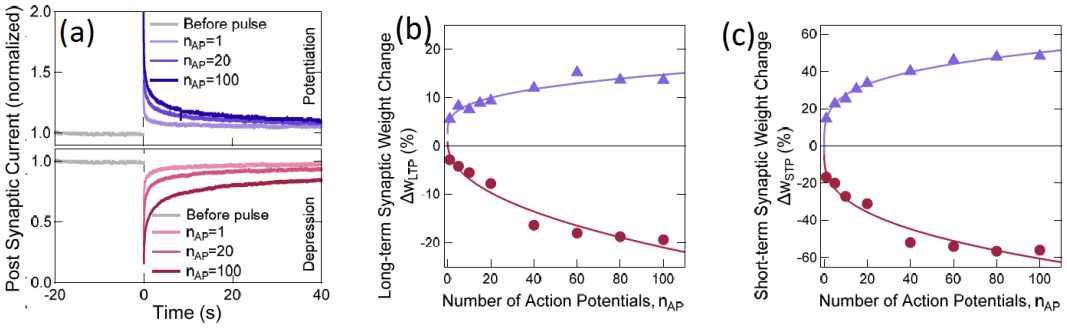

(a)
SiO2
Si
In/SiO2
patterning
(b)
SiO2
cap
In
MoOx
InP growth
(c)
InP
Device
fabrication
(d)
Source
Drain
Gate
Gate Oxide

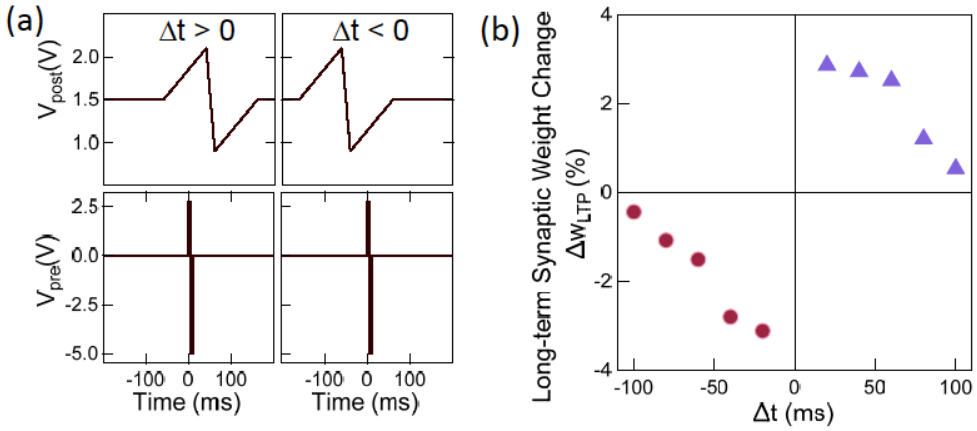

(a)
From pre-synaptic neuron
Vesicle
Synapse
Ion channel
To post-synaptic neuron
Neurotransmitter
Na+ Ion
(b)
From pre-synaptic neuron
Gate
Al2O3
Source
InP
Drain
To post-synaptic neuron
SiO2
Si


(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)
3 V
2 V
1 V
V_{gs}=0 V
I_{ds} (μA)
V_{ds} (V)


(a)
I_{ds} (mA/mm)
V_{gs} (V)
(b)
I_{ds} (mA/mm)
V_{gs} (V)
(c)
Before pulse
Elasticity (Vg=0.1 V)
Potentiation (Vg=-5 V)
Depression (Vg=+5 V)
Post Synaptic Current (normalized)
I_{ds} (mA/mm)
Time (s)
(d)
STP Data
STP Model
LTP Data
LTP Model
Synaptic Weight Change (%)
Potentiation
Elasticity
Depression
V_{gs} (V)


(a)
Post Synaptic Current (normalized)
Time (s)
Potentiation after depressing pulse
Potentiation after potentiating pulse
(b)
Depression after depressing pulse
Depression after potentiating pulse
(c)
Synaptic Weight Change (%)
No priming
Depressing priming
Potentiating priming
V_{gs} (V)


(a)
Before pulse
n_{AP}=1
n_{AP}=20
n_{AP}=100
Potentiation
Before pulse
n_{AP}=1
n_{AP}=20
n_{AP}=100
Depression
Post Synaptic Current (normalized)
Time (s)
(b)
Long-term Synaptic Weight Change
Δw_{LTP} (%)
Number of Action Potentials, n_{AP}
(c)
Short-term Synaptic Weight Change
Δw_{STP} (%)
Number of Action Potentials, n_{AP}


(a)
Δt > 0
Δt < 0
V_post(V)
2.0
1.5
1.0
V_pre(V)
2.5
0.0
-2.5
-5.0
-100
0
100
Time (ms)
(b)
Long-term Synaptic Weight Change
Δw_LTP (%)
4
2
0
-2
-4
-100
-50
0
50
100
Δt (ms)