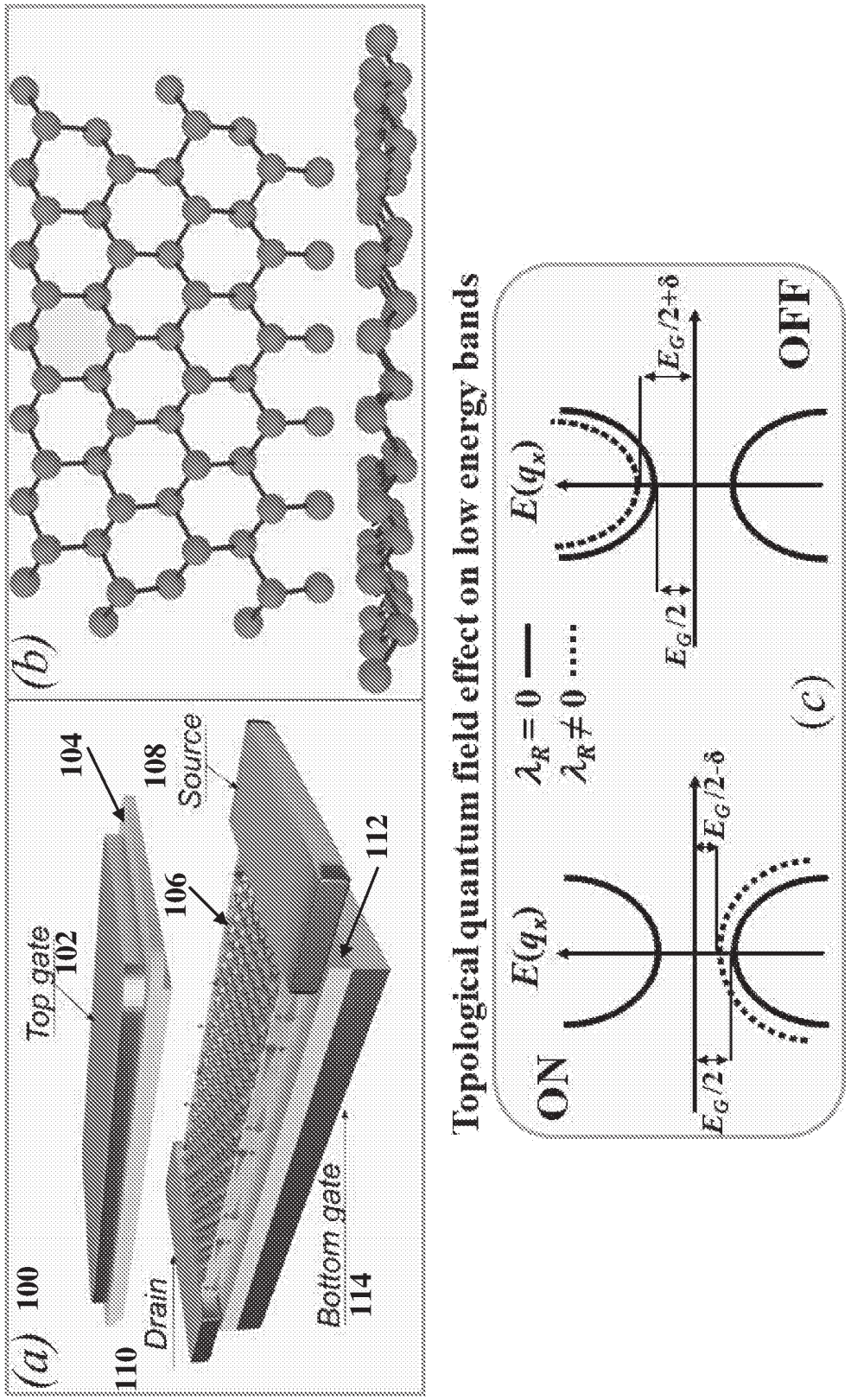

(a)
100
Top gate
102
104
108
Source
106
Drain
110
112
Bottom gate
114
(b)
Topological quantum field effect on low energy bands
ON
$E(q_x)$
$\lambda_R = 0$
$\lambda_R \neq 0$
$E_G/2$
$E_G/2-\delta$
$E_G/2+\delta$
OFF
(c)

Figure 1

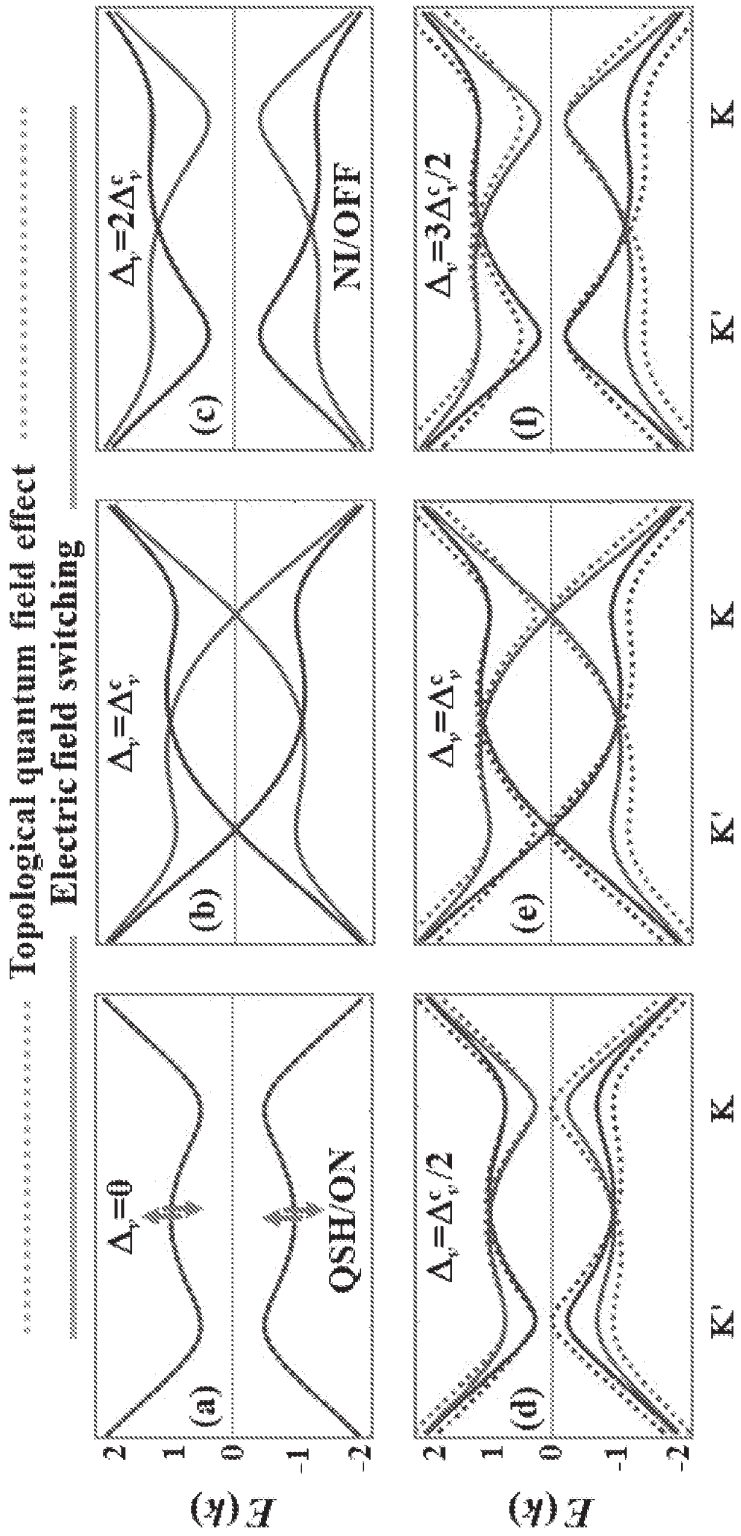

Topological quantum field effect
Electric field switching
(a)
(b)
(c)
(d)
(e)
(f)
$\Delta_v=0$
$\Delta_v=\Delta_v^c$
$\Delta_v=2\Delta_v^c$
$\Delta_v=\Delta_v^c/2$
$\Delta_v=\Delta_v^c$
$\Delta_v=3\Delta_v^c/2$
QSH/ON
NI/OFF
E (k)
K'
K

Figure 2

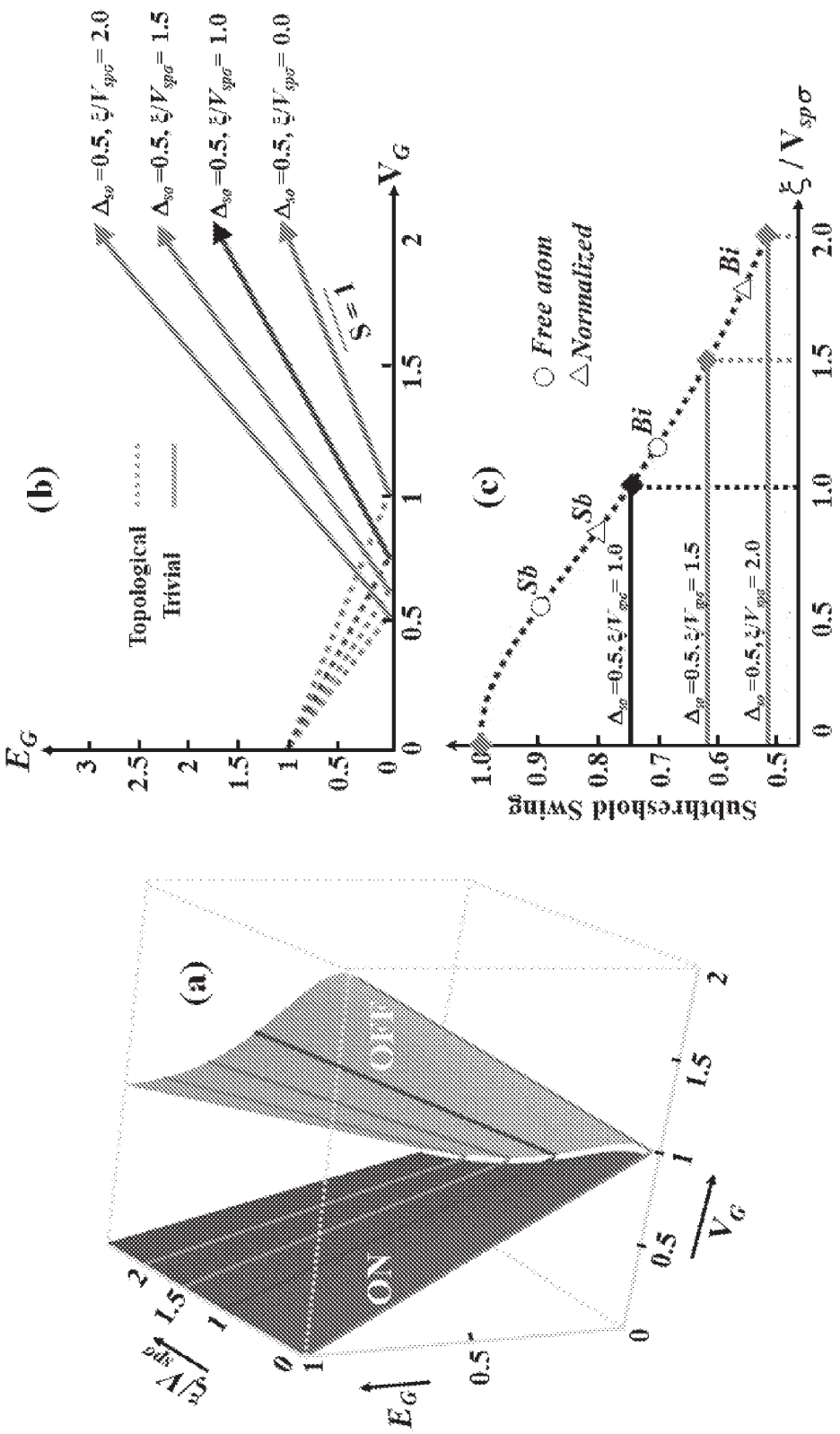

(a)
ON
OFF
E_G
$\xi/V_{sp\sigma}$
V_G
(b)
Topological
Trivial
Δ_{so}=0.5, $\xi/V_{sp\sigma}$= 2.0
Δ_{so}=0.5, $\xi/V_{sp\sigma}$= 1.5
Δ_{so}=0.5, $\xi/V_{sp\sigma}$= 1.0
Δ_{so}=0.5, $\xi/V_{sp\sigma}$= 0.0
S = 1
(c)
○ Free atom
△ Normalized
Sb
Bi
Δ_{so}=0.5, $\xi/V_{sp\sigma}$= 1.0
Δ_{so}=0.5, $\xi/V_{sp\sigma}$= 1.5
Δ_{so}=0.5, $\xi/V_{sp\sigma}$= 2.0
Subthreshold Swing
$\xi / V_{sp\sigma}$

Figure 3

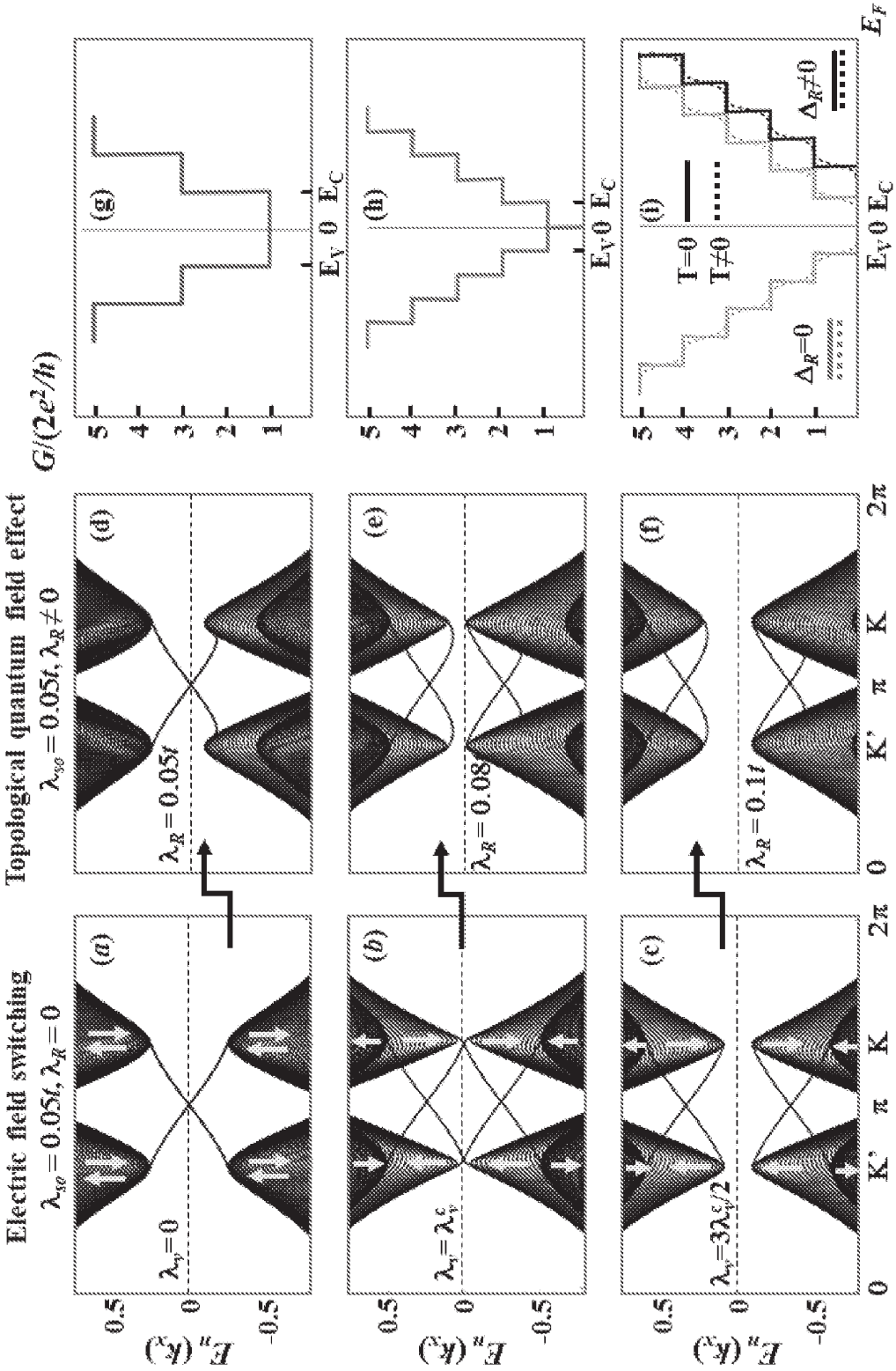

Electric field switching
$\lambda_{so}=0.05t, \lambda_R=0$
Topological quantum field effect
$\lambda_{so}=0.05t, \lambda_R\neq 0$
$G/(2e^2/h)$
(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)
(i)
$\lambda_v=0$
$\lambda_v=\lambda_v^c$
$\lambda_v=3\lambda_v^c/2$
$\lambda_R=0.05t$
$\lambda_R=0.08t$
$\lambda_R=0.1t$
$E_n(k_x)$
0.5
0
-0.5
0
K'
π
K
2π
E_V 0 E_C
T=0
T≠0
Δ_R=0
$\Delta_R\neq 0$
E_F

Figure 4