

*,**, * , ** , *

* (KIST)

** (KJIST)

I.

가 , . ,

가 , 가

. , 가

가 .

,

.

가 , MEMS (microelectromechanical system),

가 .

가 가 . [1]

● Miniaturization () :

가 가

● Stability ():

- No self-discharge: 가 가

- On-chip power source: power source on-chip 가 가

- Resistance to vibration:

20

가

1983 Kanehori [2] CVD
 $\text{Li/Li}_{3.6}\text{Si}_{0.6}\text{P}_{0.4}\text{O}_4/\text{TiS}_2$ $\text{Li/Li}_2\text{O}-\text{B}_2\text{O}_5-\text{Li}_2\text{SO}_4/\text{TiS}_2$, $\text{Li/Li}_2\text{S}-\text{SiS}_2-\text{P}_2\text{S}_4/\text{V}_2\text{O}_5-\text{TeO}_2$ 가 가 .[3,4] , Eveready Battery

Com. S. Jones $100 \mu\text{A}/\text{cm}^2$ 10,000 -
 $\text{Li/Li}_3\text{PO}_4/\text{Li}/\text{Li}$.[5]

가

CMOS

on-chip standby power 1 .[1]

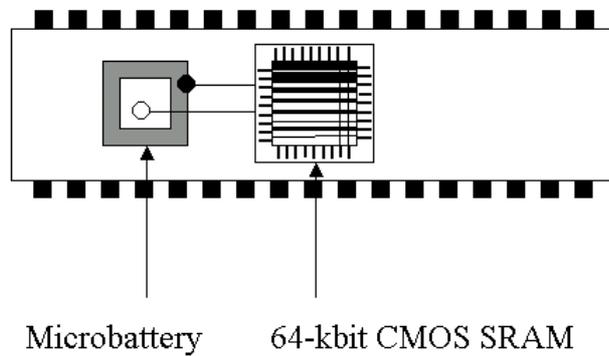


Figure 1. 가 On-chip CMOS SRAM .[1]

1993

Oak Ridge National Laboratory(ORNL)

LiPON

4.4 -

2.5V

가

가

[6,7]

가

가

가

II.

II-1.

/ /

2

Si

가

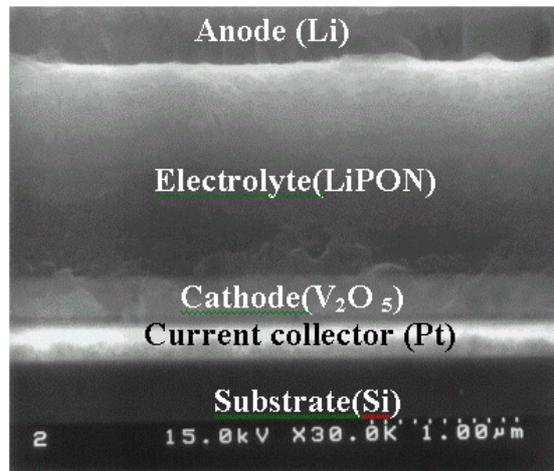
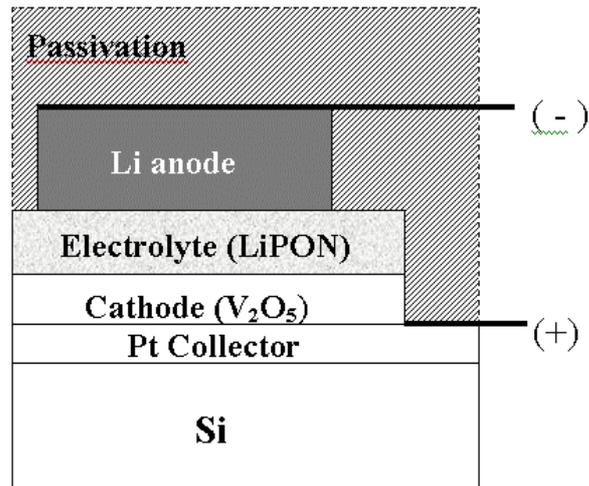


Figure 2. (a)

, (b) Li/LiPON/ V_2O_5 가

SEM

(Current collector)

5 μm ,
가 .
, rf (radio frequency)
, dc (direct current) , (e-beam evaporator),
(thermal evaporator), CVD (chemical vapor deposition), PLD (pulsed laser deposition),
Sol-gel .
가 가

A. (Current collector)

Au, Pt, Cu, Ru, Cr , ITO
Pt Pt

가 .

B. (Cathode material)

가 , , ,

가

가

V_2O_5 , $LiCoO_2$, $LiMn_2O_4$, $LiNiO_2$,

1 .[1]

Table 1.

	Amorphous V_2O_5	$LiNiO_2$	$LiCoO_2$	$LiMnO_2$
Theoretical capacity (mAh/g)	420	192	137	148
Structure	Amorphous	Layered structure	Layered structure	Spinel structure
Characteristics	Easy synthesis, Low cost, No annealing process	Low thermal stability, Difficulty of synthesis, Need to annealing	High cost, Toxic material, Need to annealing	Low cost, Stability in atmosphere, Need to annealing

TiS_2 , MoS_2

가

1.5 -2V

가

evapoation

가

$LiCoO_2$

$LiMn_2O_4$

3V

, $LiCoO_2$ $LiMn_2O_4$ 가

가

700°C

on-chip 가

가

가가

가

가

가

V_2O_5

[8]

V_2O_5 3V

가

가 가

가

가

가

가

V_2O_5

2

in-situ

가

[9,10]

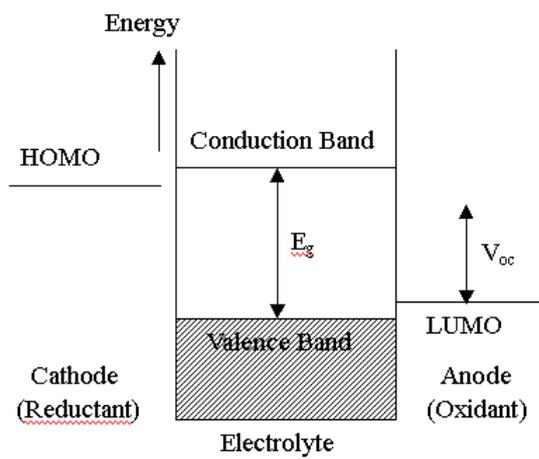


Figure 3.

band

B. (Solid electrolyte)

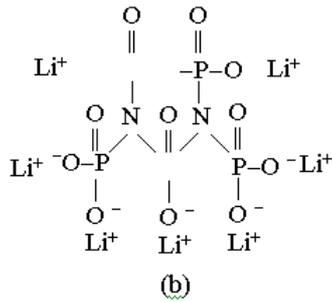
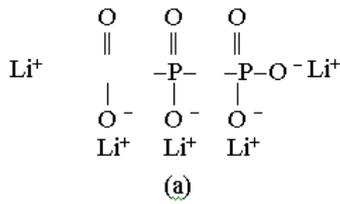
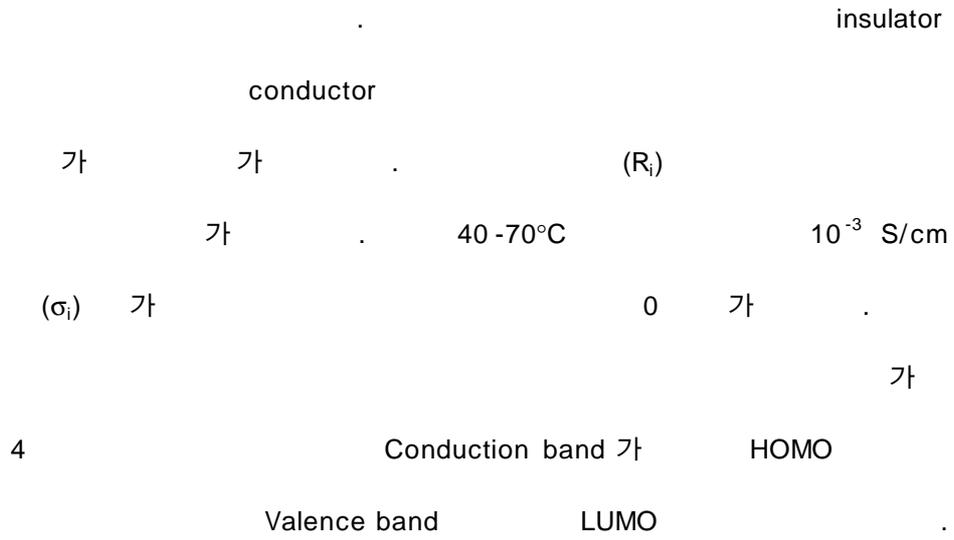


Figure 4. LiPON

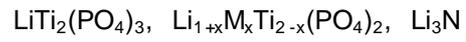
(a) LiPO_3

(b) $>\text{N}-$

cross-linking

$10^{-2} \sim 10^{-3}$ S/cm

1 μm



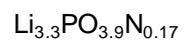
가

가

가

ORNL J.

Bates



가 가



LiPON

2×10^{-6} S/cm

가

5.5V

가

가

2

LiPON

LiPON

가 가



가

5

N

가



O



=N-

-N<

cross-linking

가

가

C.

(anode)

가

가 , 가
 가 (0.54 g/cm³) 가 , (-3.045
 V_{SHE}), (3.86 Ah/g) 가 가

(Tin -oxide) Li
 2
 4 가
 가 . 1997 Fujifilm CellTec Com
 (Trademark STALION) , Tin -oxide
 . Fuji photo film com Idota group Tin -based amorphous
 oxide Li 가 , 가

Li
 가 가 .
 가 70%
 가 ,
 가 .

II -2.

Li V₂O₅
 가 , Li
 가 5(a)가 V₂O₅
 V₂O₅ , LiPON Li ion Li⁺ + e =>
 Li
 Li LiPON LiPON
 V₂O₅ Li
 V₂O₅ LiPON Li Li d
 Li (5(b)).

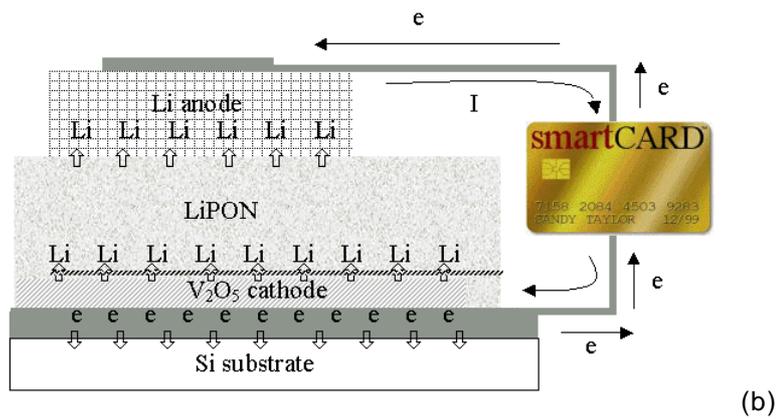
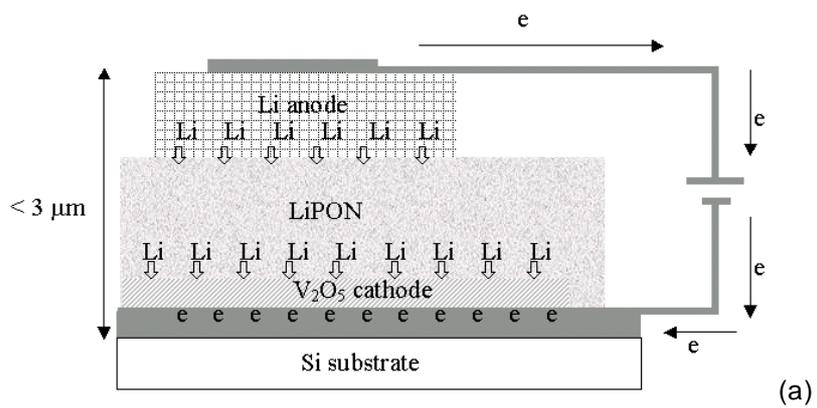


Figure 5. V₂O₅ 가

(a) LiPON Li (b)

Li

, MEMS

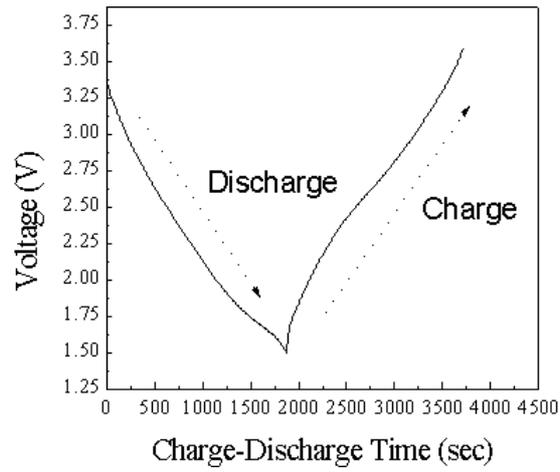


Figure 6.

III.

, TiS_2 , V_2O_5 , LiCoO_2 , LiMn_2O_4

2

Table 2.

Cathode type	TiS_2	Amorphous V_2O_5	LiCoO_2	LiMn_2O_4
Laboratory	Eveready	KIST	ORNL	ORNL
Voltage[V]	2.5 -1.8	1.5 -3.6	3.8 -4.2	3.8 -4.1
Growing method	rf sputtering	dc sputtering	rf puttering	rf puttering
Capacity [$\mu\text{Ah}/\text{cm}^2$ - μm]	75	120	60	30
Energy density [Wh/L]	500	700	800	500
Specific energy [Wh/kg]	225	420	125	190

Li

7

Li

가

plateau 가

가 cut-off

가 cut-off

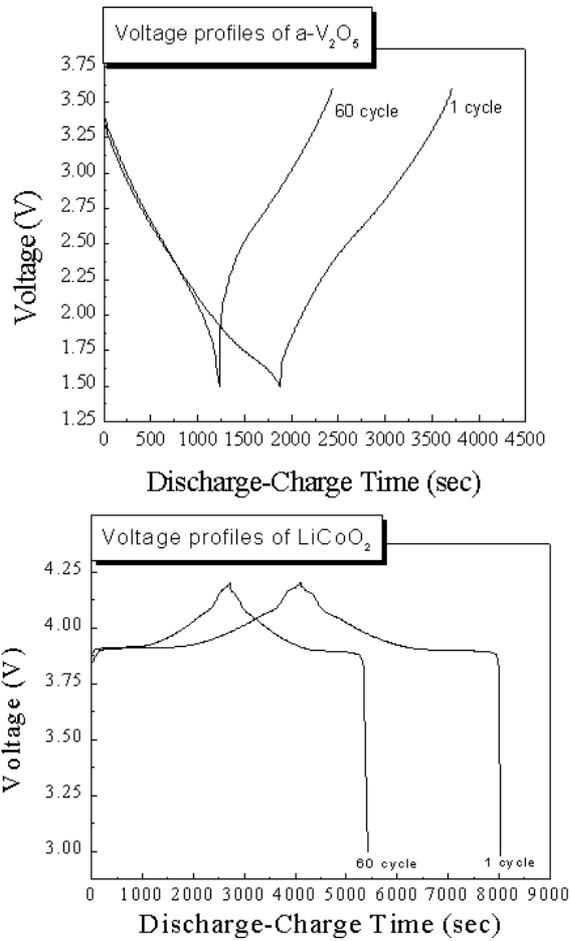


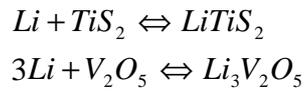
Figure 7.

(a)

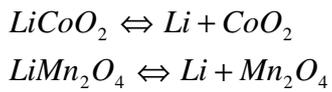
(V₂O₅), (b)

(LiCoO₂)

7(a) V_2O_5 - , -
 LiPON , LiPON V_2O_5 Li^+
 가 Li^+ Li- V_2O_5
 Li^+ cut-off
 Li-TiS₂ Li-amorphous V_2O_5 -



LiCoO₂() LiMn₂O₄() Li-TiS₂
 Li-amorphous V_2O_5
 3-4V Open
 circuit voltage Li
 가 가 -
 7(b)



가

Pt Cu V₂O₅
8 Pt
V₂O₅ .[10]

in-situ process

.[9]

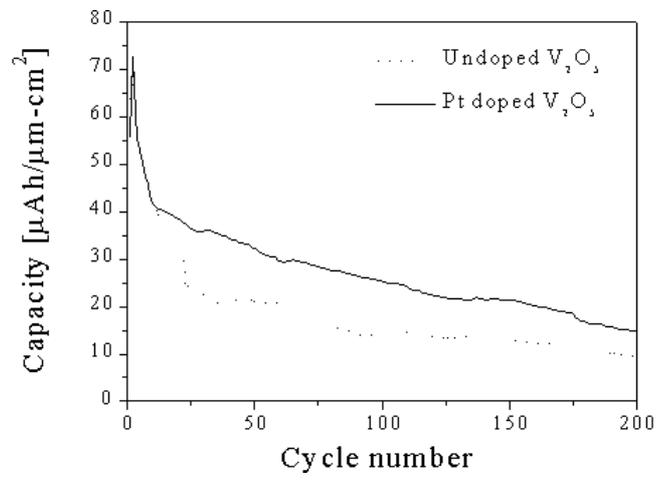


Figure 8. Pt

가

IV.

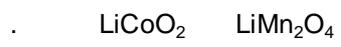
가

가



aging effect

가



가

가

가

RTA(rapid thermal annealing)

가

ORNL

Parylene

가

V.

가

가

가

9

PCS

가

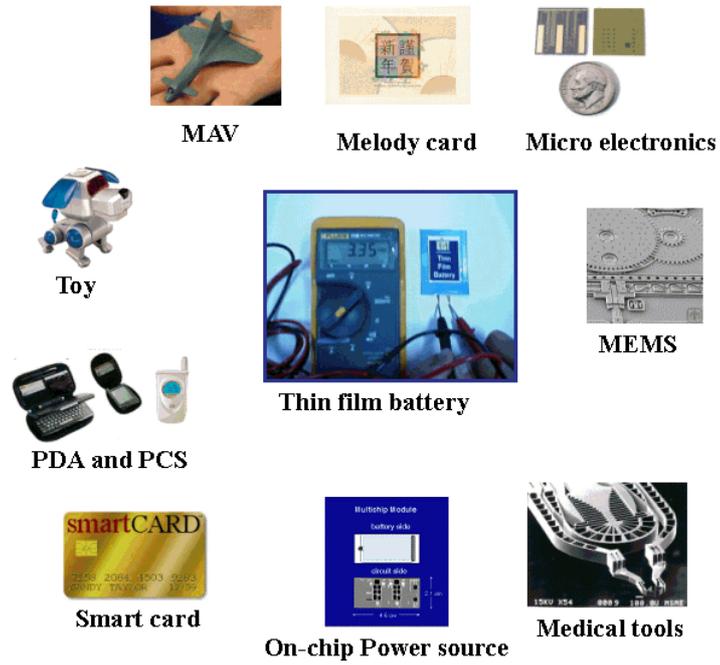


Figure 9.

3 가 가 .[12]

(MEMS: microelectronicmechanical system), on-chip power source

Table 3.

	Sensor Pill	Hazard card	Security card
Voltage [V]	3	3	3
Load (Discharge) [μ A]	3	10.3	10
Cycle life			
Discharge time	4	24	24
Number of cycle	1000	1000	1000
Battery life [year]	3	3	3
Capacity[μ Ah/cycle]	12	248	240

Dimensions [Area, cm ²]	0.2	8	9
Impedance [kΩ -cm ²]	6.5	16	90
Current density [μA/ cm ²]	15.3	1.3	1.1
Battery Loading [μAh/ cm ²]	61	31	27

on -chip

가

가

PDA

가

가

가

MAV (micro air

vehicle)

가 가

가

가

가

2007

, 2008

on -chip

power source

VI.

가

가 가
가 가
가
가 가
가 가

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