ETRI

Core Part of Subminiature Flexible Device Power

# Ultra-thin Flexible Primary Film Battery Manufacturing Technology

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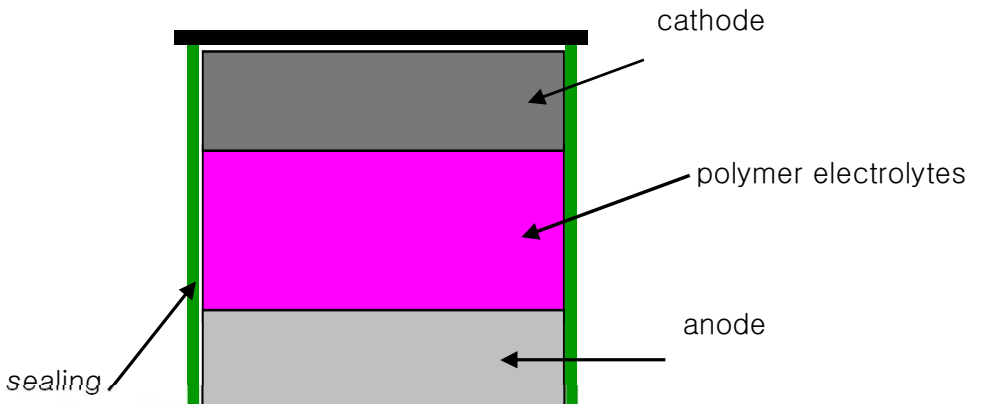
# TECHNOLOGY BRIEF

## Ultra-thin Flexible Primary Film Battery Manufacturing Technology

## ▣ Technology Overview

- **This technology is especially ultra-thin flexible film shaped primary battery manufacturing technology among power device technologies which are usually applied to RFID sensor tag, smart card, flexible display, wearable PC.**

- **Composed of cathode, anode, adhesive and post injecting polymer electrolytes, sealing/current collector, and etc.**




- **Thickness less than 400μm**
- **Nominal discharge capacity more than 3.0mAh/cm² (1.5V) and 6.0mAh/cm² (3V)**

**☐ Keywords** | Ultra-thin Flexible, Film Primary Battery, Lithium Primary Battery

**☐ TRL** 5

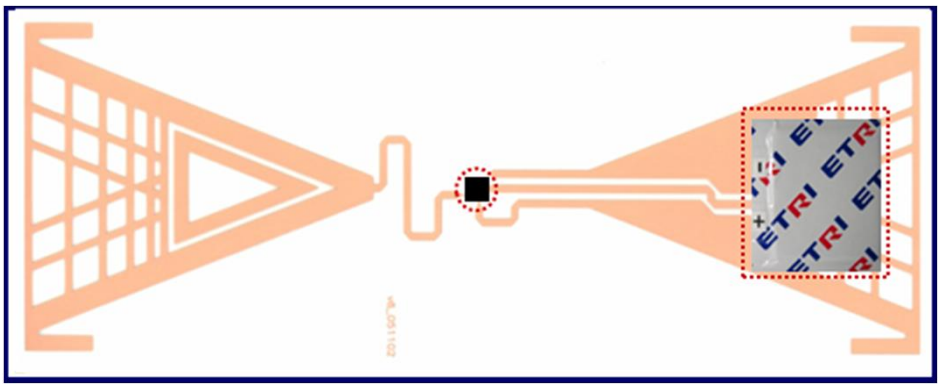
| Technology Classification Code | | |
|---|---|---|
| Sector | Sub Sector | Industry |
| Creative Convergence | Energy ICT | Energy Storage |

# TECHNOLOGY BRIEF

## Ultra-thin Flexible Primary Film Battery Manufacturing Technology

## ▣ Technology Description

- Film shaped primary battery technology for RFID sensor tag and smart card




- Hermetically sealed film battery technology with direct lamination on Al pouch and vacuum thermosetting method
- Pouch design, 1.5V cell design, 3V cell design, vacuum packing technology included

## ▣ Application Fields

- Power for RIFD sensor tag
- Power for smart card
- Subminiature power for sensor related to ubiquitous network environment
- Power for MEMS/NEMS imbedded subminiature devices
- Power for flexible display
- Power for wearable PC

## ▣ Outstanding Features

- **Lightweight, good shelf life, improved long-term stability, volatilization and leakage of electrolyte prevention are guaranteed with Al pouch which can be vacuum sealed.**
- **Direct coating of conductive layer is possible through modifying inner side of Al pouch, so Al pouch is used not only for sealing but also for current collector, and final sealing can be made by vacuum thermosetting method.**
- **Simplifies process not using metal current collector and Al/Ni tab. Also, investment in equipment and manufacturing cost is cheap since manufacturing process of 1.5V and 3V cell are same.**
- **Even if it's thinner than existing Power Paper's batteries, capacity/output is improved.**
- **Thinning, tightness, molding formability are improved since direct design of Al pouch is possible.**
- **Developed adhesive polyelectrolyte with new process having minimized electrolyte content**
- **Thinning lithium cathode reduces consumption and thus safety of cell is guaranteed.**

## ▣ IPR Status

**Korean patent 1 article registered**

| No. | Country | Application Number (date) | Status | Title |
|---|---|---|---|---|
| 1 | USA | 12708807 (2013.10.15) | Registered | Vacuum-sealing-type flexible-film primary battery |

# ▣ Technology Trend

## □ Korea

- At the year of 2005, as the first to start in Korea, ETRI started to carry researches about 1.5V manganese cell and alkaline cell shaped film primary battery.
- Now have expanded development to 3V lithium primary battery, and researching about material and process.
- Since 2005, Rocket Battery Co. is running research about improving process of manganese film primary battery to construct a mass production
- VITZRO Cell Co. has commercialized $Li/SOCl_2$ related lithium primary battery and leading domestic technologies.

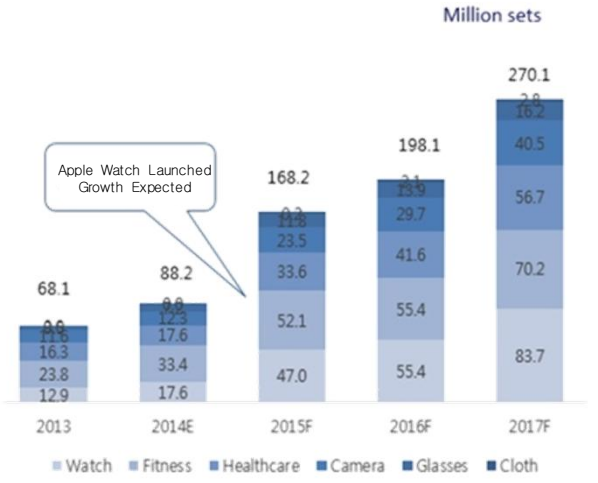
## □ Global

- Power Paper Co. in Israel has original patent of 1.5V manganese cell shaped open type film primary battery and leading relevant technology development.
- Blue Spark Technology Co. in USA is following Power Paper Co. with effort to commercialize same 1.5V film primary batteries.
- Sanyo Co. in Japan is commercializing $Li/MnO_2$ cell shaped cylindrical primary battery, and leading relevant technology development.
- Panasonic Co. in Japan has lots of patents related to lithium primary battery.

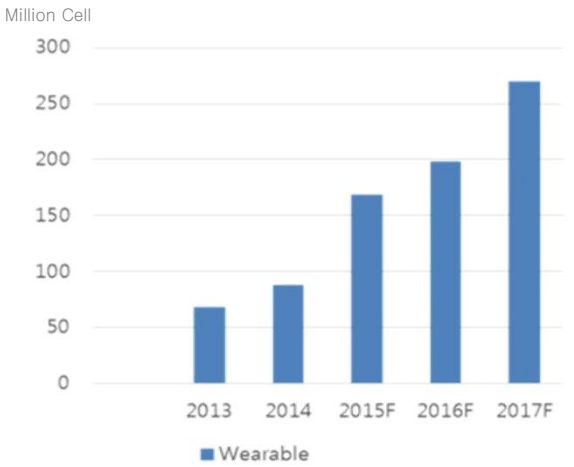
# ▣ Market Trend

- **Wearable devices and battery market outlook**

[Wearable Device Market Outlook]




[Wearable Battery Market outlook]




Reference) SNE "Global Mini Lithium Ion Secondary Battery Performance Trend and Prospects at 2014" Report (www.sneresearch.com)

## ☐ Market Leaders

### ▶ Global

- Power Paper
- Blue Spark Tech
- Sanyo
- Panasonic

### ▶ Domestic

- Rocket Battery
- VITZRO Cell

## ☐ Technology Demand

| | |
|---|---|
| **Application** | RFID Sensor Tag, Smart Card, Subminiature Human Plug-in/Built-in Equipment |
| **Industry** | Active RFID Tag Manufacturing Company, Smart Card and Medical Instruments Manufacturing Company |

## ▣ Scope of Technology Transfer

- **Thin Al Pouch Design Technology**
- **Al Pouch Surface Modification Technology : Making Hydrophilic**
- **Laminating Conductive Layer and Forming Sealing/Current Collector/Socket on Al Pouch Technology**

- **1.5V Primary Film Battery Design**
  - Cell design technology
  - Aqueous electrolyte and adhesive polymer electrolytes manufacturing technology
  - Depolarization and deliquescent additive manufacturing technology
  - Electrode material post handling and laminating slurry manufacturing technology
  - Electrode laminating technology on current collector film with screen printing method
  - 1.5V primary film battery manufacturing technology
- **3V Primary Film Battery Technology**
  - Cell design technology
  - Thin lithium foil manufacturing technology
  - Adhesive gel polymer electrolytes manufacturing technology
  - Electrode material post handling and laminating slurry manufacturing technology
  - Roll-to-roll electrode and electrolyte assembly technology
  - 3V film-type lithium primary battery manufacturing technology

## ▣ Applications and Effects

### ▶ Applications

- 1.5V Ultra-thin Flexible Primary Film Battery
- 3V Ultra-thin Flexible Lithium Primary Battery

### ▶ Effects

- 1.5V Ultra-thin Flexible Primary Film Battery
  - Reduced cost : 20% reduced contrast to Power Paper cell
- 3V Ultra-thin Flexible Lithium Primary Battery
  - Reduced cost : more than 50% reduced contrast to existing cylindrical and coin-type lithium primary battery