

Lithium-Ion Battery Materials: Latest Research Findings in 2009

➤ **Research Outline**

Yano Research Institute has conducted a study on the lithium-ion battery materials market as described below.

1. Research period: September 2008 to May 2009
2. Research targets: Lithium-ion battery manufacturers, lithium-ion battery materials manufacturers (cathode materials, anode materials, separator, electrolyte/electrolytic solution, current collecting materials)
3. Research methodologies:
Face-to-face interviews with relevant personnel, supplemented by interviews via telephone and e-mail, and literature researches.

<What are lithium-ion battery materials?>

The lithium-ion rechargeable battery used as the power source for information and telecommunication devices such as mobile phones and note PCs is comprised of more than ten components and materials. This research is focused on the materials for 5 main components which directly and significantly contribute to the characteristics of the lithium-ion rechargeable battery, which are cathode, anode, separator, electrolyte/electrolytic solution and current collector.

➤ **Key Findings**

- ◆ **The market size of the 5 components materials (cathode materials, anode materials, separators, electrolytes and current collectors) for lithium-ion battery in fiscal 2008 is estimated to be 214.2 billion yen, increased by about 16.6 percent compared to the previous fiscal year.**
 - Cathode materials account for 92.184 billion yen, increased by 14.0 percent
 - Anode materials account for 26.2 billion yen, increased by 15.9 percent
 - Separators account for 66.87 billion yen, increased by 19.7 percent
 - Electrolytes account for 9.221 billion yen, increased by 20.1 percent
 - Copper foil for anode accounts for 16.192 billion yen, increased by 16.2 percent, and aluminum foil for cathode 3.542 billion yen, increased by 30.4 percent respectively.
- ◆ **The market size of the 5 components materials for lithium-ion battery in fiscal 2011 is estimated to be 234.5 billion yen**

The demand for lithium-ion rechargeable batteries will continue to be driven by portable devices such as mobile phones and note PCs until fiscal 2011. As a new demand, installations on middle-size devices such as power tools and motor drive scooters are expected to keep increasing in the future. Automotive applications, which may increase the demand for lithium-ion battery considerably, are expected to go into full swing in 2012 to 2015.

➤ **Report format:**

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Contacts: Public Relations

Yano Research Institute Ltd. (URL: <http://www.yanoresearch.com>)

Phone: +81-3-5371-6912

E-mail: press@yano.co.jp

➤ Research Summary

1. Market overview

The market size of the 5 components materials (cathode materials, anode materials, separators, electrolytes and current collectors) for lithium-ion battery in fiscal 2008 is estimated to be 214.29 billion yen, increased by 16.6 percent compared to the previous fiscal year. In the first half of the fiscal 2008, the demand has increased, significantly exceeding the shipment volume in fiscal 2007. However, impacted by the world recessions from October or so, the demand for lithium-ion batteries has become sluggish in the latter half of the fiscal 2008. As a result, temporal suspension of shipment has been observed for some materials in middle of November, and the market size of lithium-ion battery materials in fiscal 2008 in total remained with a limited growth of 16.6 percent compared to the previous fiscal year. The major applications were portable devices such as mobile phones and note PCs.

2. Trend by type of material

2-1. Cathode materials

Although the lithium cobalt oxide used to be the main cathode material in the past, due to its violent price fluctuations in addition to its thermal stability issue, a trend of avoiding the use of cobalt is becoming apparent. The use of alternative materials is expected to increase, such as ternary (cobalt/manganese/nickel) with high design flexibility, lithium manganese oxide which is relatively low priced and superior in thermal stability, and lithium nickel dioxide which is lower in price compared to cobalt and superior in high capacity characteristics.

2-2. Anode materials

Currently, the ratio of synthetic graphite suitable for achieving higher capacity is high in the shipment. As the limitation of synthetic graphite in achieving higher capacity is beginning to be observed and the price is higher, however, the demand is beginning to shift to natural graphite which can provide similar capacity with lower price. In the meantime, although there is a new metal-base anode material which may achieve higher capacity, the shipment is still limited to a certain applications due to its higher price and thermal stability issue.

2-3. Separators

Majority of the separators on the market are conventional single or multi-layered types with polyolefin resin such as polypropylene or polyethylene. Triggered by recent heat-up accidents, however, it has become necessary to improve the safety. Under these circumstances, a new separator coated with highly heat-resistant aramid has been commercialized as a high value-added product.

2-4. Electrolytes

At present, LiPF_6 is mainly used as an electrolyte, and the production technology is approaching to its perfection. As the degree of perfection as a product is very high, cost reduction has become the highest priority issue. However, the cost reduction in the production process is approaching to the limits, as further cost reduction will require still greater energy cost reduction and the production volume as large as 3 times of the current production.

2-5. Current-collecting materials

Copper foil is used for anode and aluminum foil for cathode, both of which are in cost reduction competitions. There are two types of copper foils for anode application, electrolytic copper foil and rolled copper foil. As miniaturization and high capacity achievement are required for the battery, electrolytic copper foil has an overwhelming share in the shipment. For cathode, only rolled aluminum foil is used. Under severe price competitions, a new movement is observed for developing and proposing a new, high value-added product. Along with the increase of new demand of rechargeable batteries for medium to large size devices, the demand for thicker foils, both for copper and aluminum foils, suitable for high output applications is expected to increase from now on.

3. Future Perspectives

The market size of the 5 components materials (cathode materials, anode materials, separators, electrolytes and current collectors) for lithium-ion battery in fiscal 2011 is estimated to be 234.5 billion yen.

Up to date, most of the demand for lithium-ion battery has been for small portable devices such as mobile phones and note PCs. The demand for such small devices is expected to steadily increase in the future, as mobile phone may increase its importance by taking a role of social infrastructure in certain regions, and the demand for note PCs will continue increasing as UMPC (ultra mobile PC) is

introduced and rapidly increasing. Also, the installation of lithium-ion battery is increasing on medium size devices with motor drive mechanism, such as power tools, motor drive scooters and motor assist bicycles.

In response to these increases of lithium-ion battery applications and demand, leading lithium-ion battery manufacturers have announced their plans for production capacity increase one after another. It is expected, therefore, that the demand for lithium-ion battery materials will increase steadily in the future. For small devices, still higher capacity achievement will be required, while higher output capacity and safety features such as heat-resistance will be required for medium to large size devices. In order to cope with these ever increasing requirements, activities on the development of new materials are accelerating for breaking through the limits of existing materials.

Automotive applications, expected to increase the demand for lithium-ion battery considerably, are expected to go into full swing in 2012 to 2015. Along with the progress of automotive applications, the sharp rise of demand for lithium-ion battery materials for automobile is expected to start in or after 2012. As the standardization of batteries and materials for automobile application has not been established yet, materials which have been used and proved for portable devices are used as basic materials for automotive applications as well. Lithium-ion battery material manufacturers are continuing their research and development activities in preparation for the rapid development of battery materials market for automotive applications in or after 2012.

Table 1: Lithium-ion battery materials: world market size transition and forecast

(Unit: Million yen)

	FY 2007		FY 2008 (Projection)		FY 2009 (Forecast)		FY 2010 (Forecast)		FY 2011 (Forecast)	
	Value	Share	Value	Share	Value	Share	Value	Share	Value	Share
Cathode material	80,887	44.0%	92,184	43.0%	90,000	43.0%	96,793	43.0%	100,000	42.6%
Anode material	22,600	12.3%	26,200	12.2%	25,676	12.3%	27,217	12.1%	28,305	12.1%
Separator	55,860	30.4%	66,870	31.2%	65,000	31.1%	69,800	31.0%	73,000	31.1%
Electrolyte	7,680	4.2%	9,221	4.3%	9,100	4.4%	10,000	4.4%	10,500	4.5%
Copper foil	13,940	7.6%	16,192	7.6%	16,100	7.7%	17,700	7.9%	18,900	8.1%
Aluminum foil	2,717	1.5%	3,542	1.7%	3,300	1.6%	3,600	1.6%	3,800	1.6%
Total	183,684	100.0%	214,209	100.0%	209,176	100.0%	225,110	100.0%	234,505	100.0%

(Estimated by Yano Research Institute)

* Based on the shipments from manufacturers

* Based on the shipments in value

* Based on the world market

Graph 1: Distribution of world lithium-ion battery materials market in fiscal 2008

