

**Evaluation Form – Technical Review Paper**

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\_\_\_\_\_ / 30    Technical Content

- Current state-of-the-art and commercial products
- Underlying technology
- Implementation of the technology
- Overall quality of the technical summary

\_\_\_\_\_ / 30    Use of Technical Reference Sources

- Appropriate number of sources (at least six)
- Sufficient number of source types (at least four)
- Quality of the sources
- Appropriate citations in body of text
- Reference list in proper format

\_\_\_\_\_ / 40    Effectiveness of Writing, Organization, and Development of Content

- Introductory paragraph
- Clear flow of information
- Organization
- Grammar, spelling, punctuation
- Style, readability, audience appropriateness, conformance to standards

\_\_\_\_\_ / 100    **Total - Technical Review Paper**

# Mobile Device Battery Technology

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# Mobile Device Battery Technology

## Introduction

This is a review of current battery technology that is used in mobile phones, and other similar mobile devices.

## Commercial Applications

There are numerous battery chemistries available commercially, with an even larger number of manufactures all over the globe. All of the four following battery types are mainly used in laptops, mobile phones, and other portable devices where high capacity is needed within small sizes. Nickel Cadmium (NiCd) batteries are mature and well understood but relatively low in energy density. The NiCd is used where long life, high discharge rate and economical price are important. The NiCd contains toxic metals and is environmentally unfriendly. Nickel-Metal Hydride (NiMH) has a higher energy density compared to the NiCd at the expense of reduced cycle life. NiMH contains no toxic metals [1]. Lithium Ion (Li-ion) battery use is the fastest growing of the commercially available technologies. Li-ion batteries are used where high-energy density and lightweight is of prime importance, excluding cost. The technology is fragile and a protection circuit is required to assure safe charging and discharging [2]. Lithium Ion Polymer (Li-ion polymer) technology offers the attributes of the Li-ion in ultra-slim geometry and simplified packaging with potentially reduced cost as the technology and manufacturing capacity matures [1].

## Underlying Technology

Measuring the performance of any battery consists of recording the following commonly used measurements. Internal Resistance, which decreases the terminal voltage of the cell during discharge and increases the voltage needed to charge the cell reduces its capacity and

charge/discharge efficiency. Lower internal resistance is the most desirable characteristic.

Discharge rates show the relationship between the overall power supplied vs. a specific length of time. A smaller load delivered over a longer period of time will actually deliver more energy than the opposite condition [3]. A small difference between discharge rates is preferred. Self-discharge characteristics measure the rate at which a battery will “die” without having been used. Temperature characteristics describe the decrease in discharge voltage as temperature lowers [4].

## **Building Blocks**

While most batteries on the market have a large stacked cell structure, and large connecting anodes and cathodes, some Li-ion batteries have been produced with 3D printers on the nano scale. Printing the batteries would allow for much faster and cheaper production [5]. The raw materials for Li-ion batteries are lithium metal, and a metal such as copper or manganese oxide that forms the ion exchange. The internal reactions are reversible to allow for recharging, but in the process, the electrodes degrade over time. Li-ion and NiCd batteries are fragile and in order to use their energy effectively, they must be accompanied by a protective power circuit that prevents voltage and current spikes from damaging the internal components [6].

## **Conclusion**

Li-ion battery technology offers the performance properties of best power to weight ratio, internal resistance, and self-discharge rate among others, but lacks competitiveness with other technologies on the aspect of price. Extending the trend in Li-ion battery price and production scale, Li-ion cost will soon be lower than the others. Its high-performance properties that surpass the other available technologies will then be affordable [6].

## References

- [1] I. Buchmann. (2013, October 15). *What's the best battery?* [Online]. Available: [www.batteryuniversity.com](http://www.batteryuniversity.com)
- [2] C. Kim, "A Modularized Charge Equalizer Using a Battery Monitoring IC for Series-Connected Li-Ion Battery Strings in Electric Vehicles," *IEEE Trans. Power Electron*, vol. 28, no. 8, Aug 2013.
- [3] (2013, October 15). *Battery Performance Characteristics* [Online]. Available: [www.mpoweruk.com/performance](http://www.mpoweruk.com/performance)
- [4] Y. Liu, "Improvement of storage performance of LiMn<sub>2</sub>O<sub>4</sub>/graphite battery with AlF<sub>3</sub>-coated LiMn<sub>2</sub>O<sub>4</sub>," *Ionics*, vol. 19, Jan 2013.
- [5] K. O'Donnel, "Micro Batteries," *Bloomberg Businessweek*, no. 4339, pp. 34, July, 2013.
- [6] R. A. Huggins, "Applications of Electrochemical Energy Storage," in *Advanced Batteries*. New York: Springer, 2010, pp v-x.