Batteries for energy generation and storage: A perspective from MIT professor and entrepreneur Yet-Ming Chiang

With a founding role in four companies, Massachusetts Institute of Technology (MIT) Professor of Materials Science and Engineering Yet-Ming Chiang exemplifies the entrepreneurial spirit that nourishes the American high-tech sector. Beginning in 1987, he was one of four MIT co-founders of American Superconductor, a startup that has become the world's leading supplier of high-temperature superconducting wire. Fourteen years later in 2001, Chiang joined with a Boston-area venture capitalist and others to form A123 Systems, which has become an industry leader in the development of nanophosphate-based lithium ion batteries, whose high power, long life, and safe operation make them ideal for power tools, electric and hybrid vehicles, and grid storage systems. Subsequently, in 2007, with an MIT colleague, Chiang co-founded a third company called SpringLeaf Therapeutics, which is turning battery-derived technology into a smart transdermal patch to infuse drugs at a controlled release rate. The most recent startup is a company called 24M Technologies, which is working on a new type of flow battery, a form of rechargeable battery in which electrolyte containing one or more dissolved electroactive species flows through an electrochemical cell that converts chemical energy directly to electricity. In our interview with Chiang, we asked him to draw on his entrepreneurial and MIT research experience on advanced materials and related device technologies while giving his perspective on the state of battery technology for energy generation and storage.

MRS BULLETIN: You have started four companies so far. What motivates you to pursue this special kind of tech transfer so frequently?

YET-MING CHIANG: I don’t want people to get the impression that starting a company is something that I—or, really, any other academic I know whom has done it—spend all my time thinking about, that my objective is to start companies. It’s truly one of those things that, in carrying out research, once in a while and, typically infrequently, all the elements coalesce in the right way.

The way it is—for me, at least—is that I have a research portfolio that ranges from fundamental research funded by DOE’s Office of Basic Energy Sciences or NSF, to projects that are a little more applied, and at the other end, to projects that are rather mission oriented and typically backed by either DARPA or ARPA-E. Every once in a while, all of the key elements come together: a research result that occurs simultaneously with a clear, technological, and societal need and then, very importantly, the other people that are necessary to form a startup.

How did this process work in the case of A123 specifically?

We thought we had some ideas for a new way to make batteries based, in part, on the discovery that cells with cathodes made from doped lithium-transition metal-phosphate nanoparticles had vastly increased charge–discharge rates, as fast as once every three minutes. That really was the key observation that led us to believe that there was a technology that could be built around this.

Based on those small-scale lab tests, we thought that the chemistry and materials had a lot of potential for batteries to address large-scale, high-power applications. And, in looking around at what existed, we converged on power tools—then a $4 billion worldwide market—rather than the high-energy-density, portable electronic devices that had dominated the lithium-ion market.

The kinds of questions that had to be answered were: Could these materials be made cost-effectively and in quantity while still preserving the properties that we observed in small samples? The second was whether a complete battery chemistry and battery design could be developed that would take advantage of what we saw at the laboratory scale. A battery, even though it looks very simple, is a complicated chemical, electrical, and mechanical device. A123 was formed in 2001 to find out.

Your initial direction was power tools. Have you expanded beyond that? Have the other applications, such as transportation and the electricity grid, captured the interest of A123?

Those are the two main markets that A123 is going after. In 2001, there was almost no commercial interest in
George Crabtree was interviewed by MRS Bulletin representatives

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