Tin, the forgotten electric vehicle metal

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Tin has largely been overlooked in the buzz surrounding the expected growth of the electrical vehicle (EV) market in coming decades; however, ongoing analysis of industry trends and progress in research and development (R&D) by the International Tin Association (formerly ITRI) has demonstrated that tin has an important role to play in advanced lithium-ion, and even 'post-lithium', battery technologies that could be used in the EVs of the future.

The proliferation of electronics in vehicles, and the growth in electricity generation and storage infrastructure, will need to accompany the growth of EV; both present exciting opportunities for future tin demand growth.

Batteries lead the way

Energy storage in batteries is a key focus for commodity investors today, with an expected surge in metals use

Tin ingots – PT Timah

for both stationary applications and EV markets. As energy demands spiral and electricity replaces fossil fuels in a bid to slow climate change, there will need to be massive new capacity to store electric charge. The battery market in general is expected to grow by 7.7 per cent by 2020 and lithium-ion batteries, in particular, by 16 per cent over the same period.

Currently lead-acid batteries are the major technology used in vehicles, and this will continue until around 2025, when lithium-ion and other more efficient technologies will start to have a significant impact. Tin is used at up to 1.5 per cent in lead-acid battery grids, boosting performance, and already lead-acid batteries has grown to be the fourth largest use of tin, representing 28,000 tonnes per annum tin in 2015 and forecast to peak at 36,000 tonnes per annum in 2025. The growth of e-bikes in China has been a very significant factor, but going forward, the shift to high-performance hybrid 'start stop' and 48-volt vehicles will drive growth. Other markets in 4G telecoms, grid storage and electric forklifts, for example, are also significant opportunities.

But it is lithium-ion batteries that are attracting most attention from investors at present, especially in the context of the introduction of electric vehicles, spurred by pressure on governments to combat climate change, reduce air pollution and save lives. Norway and Netherlands want to completely ban petrol and diesel vehicles by 2025, while China has launched a series of quotas and credits to become completely 'electric' by 2030. Major car industry announcements have followed, with a rush to deliver hybrid and full EV options.

Battery research and development highlights tin potential

The International Tin Association has been tracking hundreds of publications and patents detailing the development of tin in at least four generations of lithium battery technology over the last year.

The main focus for tin is in the positive anode electrode of lithium-ion batteries, usually made today from graphite on a copper foil. Next-generation products are already adding silicon into the graphite to increase capacity. Some will probably use tin, either as an alternative or in addition to enhance silicon performance. For example, China's largest electric vehicle producer, BYD, recently patented a tin-cobalt-carbon technology for anodes. Tin oxide, tin-phosphorus, tin-sulphur and similar combinations have also been shown to be capable of replacing graphite altogether with performance

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gains through higher capacity.

Already, the next generation of pure metal anodes is under development, scheduled for 2019–23, including tin and tin alloys. Most recently, start-up StoreDot, which claims to be able to charge batteries in just five minutes, patented tin metal use in lithium-ion anodes, while Nissan have patented a silicon-tin-titanium alloy. Beyond 2023, it is expected that pure lithium or silicon anodes will take battery capacities to 10 times what is possible today, and alloying both with some tin has been shown to enhance performance by General Motors, Nissan, 3M and others.

Cutting across all of these developments is the development of solid state lithium-ion technologies that radically redesign the basic battery cell, replacing the liquid electrolyte with safer solid materials, including yet another potential use for tin. For example, Toyota has announced its intention to launch a solid state vehicle by 2022. Solid electrolytes with tin are already available commercially, and Toyota's Tokyo University research team has been experimenting with a LSSPS (lithium tin silicon phosphorus sulphur) variant. It won't be clear for some time which of the many closely guarded lithium-ion battery technologies will win out, but within the mix there are multiple opportunities for tin.

Preparing for 'post lithium'

Despite the intense focus on lithium-ion technologies, so-called 'post lithium' battery chemistries are already advancing rapidly. Sodium-ion is in the lead, with magnesium and even potassium-ion coming up behind. This is good news for tin, as both tin compounds and tin alloys feature even more prominently in anode technologies for this type of battery. Toyota, for example, has been working with tin-antimony alloys, while start-up Faradion is using some tin in its sodium-ion products.

Energy markets to boost solder use

One spin-off effect of the rapid growth in new energy technologies is expected to be a boost to tin use in solders. Already, there has been some measurable impact of solar photovoltaics (PV) growth through increased use of solder ribbon to join solar panels, representing around 7500 tonnes of tin use in 2016. If joining technology remains the same, this market could be set to grow to 14,000 tonnes per annum by 2030. Electric vehicles will require greater electronics and electrical systems in the future, in addition to the electronic proliferation from more infotainment and self-driving technologies on board. At the same time, it is expected that much more solder will be used in electronics' control systems and associated renewable energy infrastructure, both locally and regionally, for solar PV, as well as wind energy, new utility energy networks and eventually the hydrogen economy.

Many other tin energy uses are in R&D around the world, including liquid metal batteries, fuel cells, thermoelectric materials and even hydrogen technologies. Only time will tell which of these will eventually impact the metal, but evidently the future of tin in energy uses seems bright.

Want to learn more?

2018 International Tin Conference

- To be held at the Corinthia Hotel, Budapest, 23–25 April 2018.
- The world's biggest international tin event.
- Suitable for anyone with an interest in the tin market.

Tin Industry Review 2017 – 'Navigating Global Uncertainty'

- Authoritative industry report available immediately.
- A market-leading report for tin users, producers, explorers and investors.
- Answering all your questions on the global tin market and outlook.

Contact the International Tin Association for more information: www.internationaltin.org