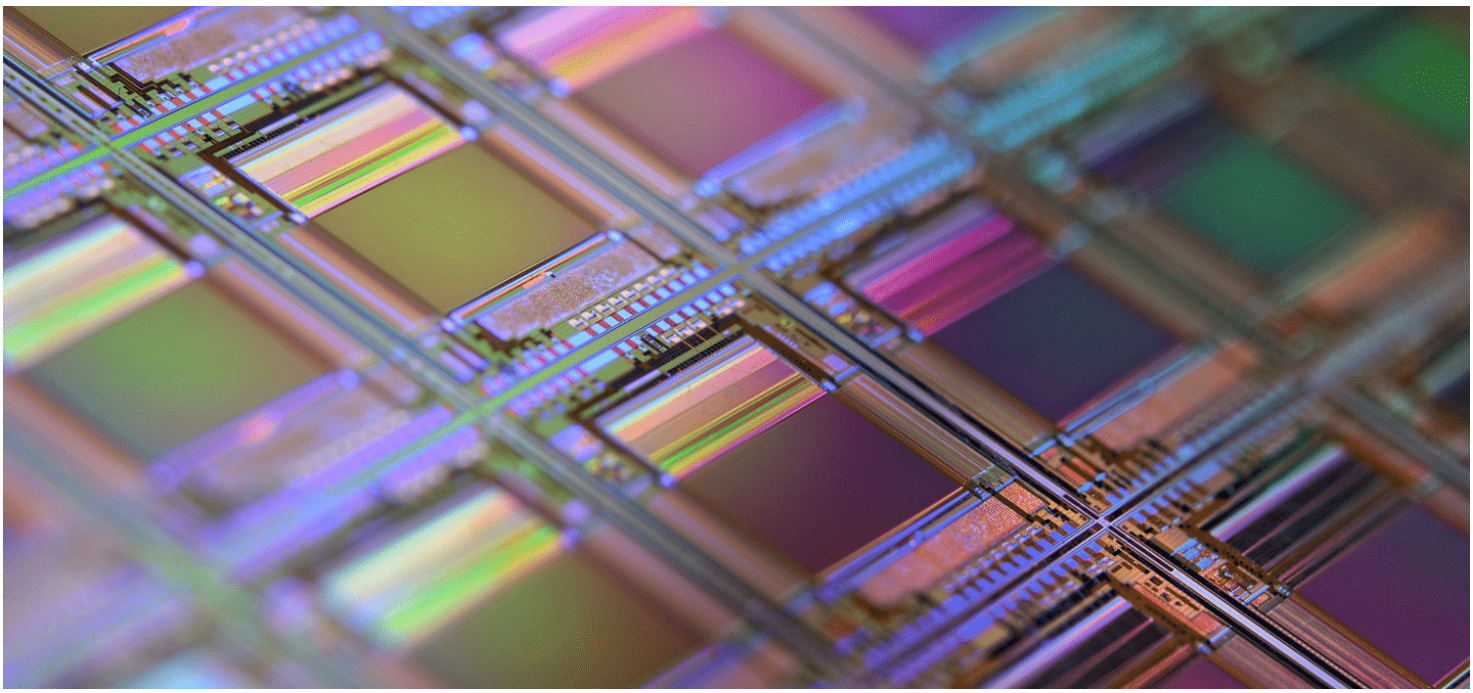

The team used micro-silicon, which is less processed and less expensive than the nano-silicon which is normally used. | Photo source Laura Ockel

NEW SOLID-STATE BATTERY USES SILICON TO DELIVER HIGH PERFORMANCE

AGRICULTURE & ENERGY

Researchers have developed a solid-state battery that uses a silicon anode to deliver more storage capacity and higher energy density

Spotted: A carbon-free (or at least carbon-light) future hinges on developing efficient battery technology. Researchers working to develop this have largely followed two different tacks: the use of solid-state electrolytes and the addition of silicon to battery anodes to increase energy density. Now, researchers at the University of California, San Diego have had some success in combining these approaches into one battery.

While silicon offers more storage capacity than conventional graphite, in practice lithium-ion batteries that have been boosted with silicon suffer from poor performance. This problem is caused by the interaction between the silicon and the liquid electrolytes in the battery. To get around this, the San Diego team eliminated the carbon and the binders normally used in all-silicon anodes. They also used micro-silicon, which is less processed and less expensive than the nano-silicon which is normally used.

Rather than a liquid electrolyte, the team used a sulfide-based solid electrolyte, which is extremely stable when paired with all-silicon anodes. By replacing the carbon in the anode with silicon, the team reduced the unwanted side reactions that come with having two liquids which, in turn, avoided the continuous capacity loss that generally occurs with liquid-based electrolytes.

Darren H. S. Tan, who spearheaded the research, explained that "With this battery configuration, we are opening a new territory for solid-state batteries using alloy anodes such as silicon." Tan has co-founded the start-up, UNIGRID Battery, which has licensed the technology. Additional work on the batteries will also continue at UC San Diego, in collaboration with LG Energy Solution.

As the world transitions from fossil fuels to more responsible forms of energy, improved battery technology is going to be vital. Researchers are stepping up to this challenge, with innovations that include an electric vehicle battery that can charge in just ten minutes as well as a super-efficient micro-battery.

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Takeaway:

Pairing silicon anodes with solid-state technology makes it possible to overcome a number of the limitations of conventional batteries, including reducing cost, and allowing fast charge rates while maintaining high energy density. Tan pointed out that “The solid-state silicon approach … presents exciting opportunities for us to meet market demands for higher volumetric energy, lowered costs, and safer batteries, especially for grid energy storage.” These batteries may represent the next stage in battery evolution. A longer-lasting and more sustainable battery is imperative if electricity is going to replace fossil fuels.