Multifunctional Energy Storage (MES) Composites

Stanford University & Farasis Energy, Inc.

Multifunctional Battery Chassis Systems for Automotive Applications

Performing Organization
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Technology Overview

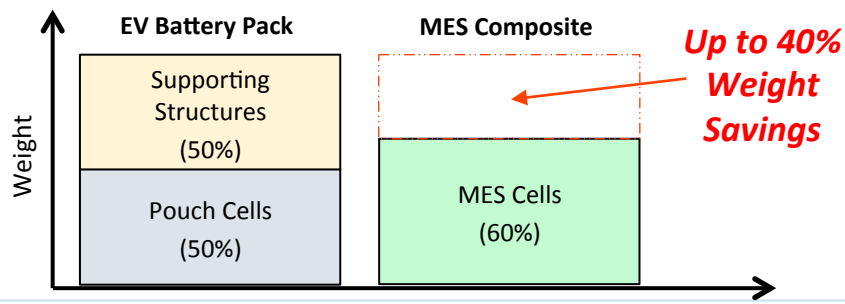
MES Composites seamlessly embeds li-ion battery materials into high-strength carbon-fiber composites, together with embedded micro-sensors:

- **Synergy** – concurrently carry mechanical loads, as well as provide electrical energy.
- **Configurable –** customizable to achieve system-level performance optimization.

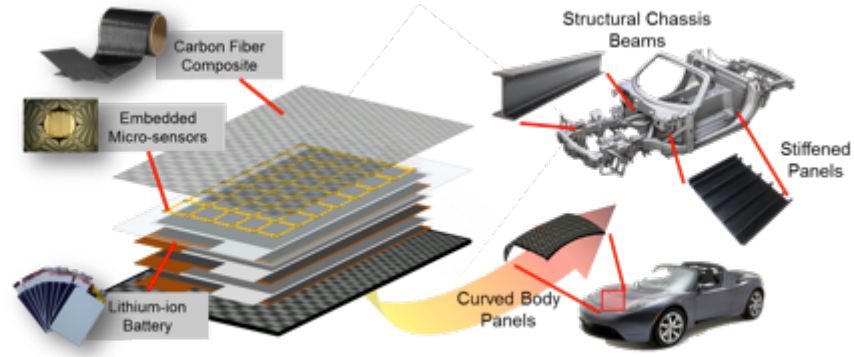
Advantage and Differentiation

Metric	*Threshold*	Pouch Cell	MES
Specific Energy	>150Wh/kg	YES	YES
Energy Density	>230Wh/L	YES	YES
Specific Stiffness	>8GPa/g/cm^3	NO	*YES*
Bending Rigidity	>260Nm^2/kg	NO	*YES*

EV System Application with Same Capacity



Multifuntional Energy Storage Composites



Tangible Deliverables

Year	Deliverable
1	Realization of Functional MES Composite cells
2	Multi-cell mini-module 130 Wh/kg; 20X stiffer
3	Multi-cell large-scale module: >150 Wh/kg

Project Statistics

Award Amount	$2.71M
Award Timeline	Nov. 2013 – Nov. 2016
Project Location	Stanford University, CA

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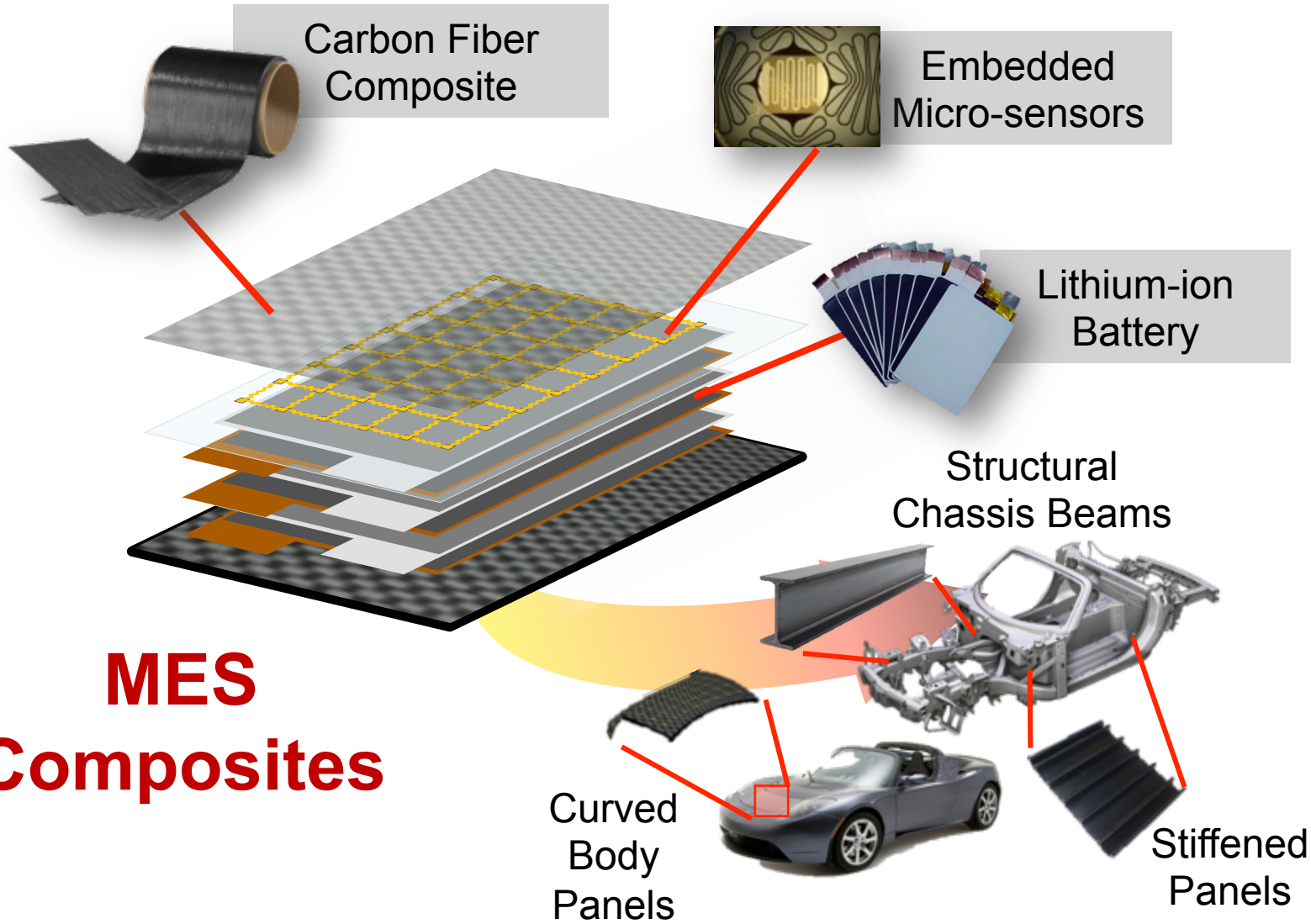

MES Composites

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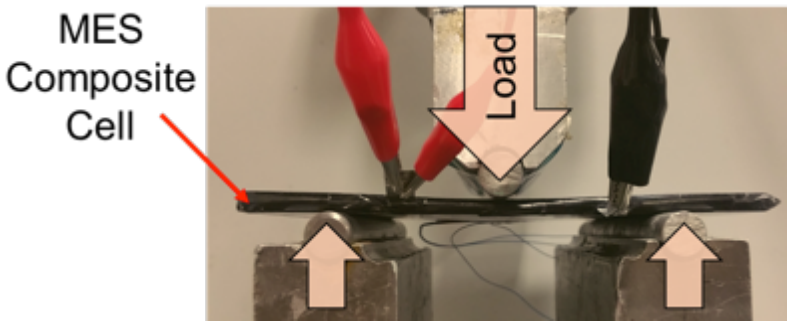
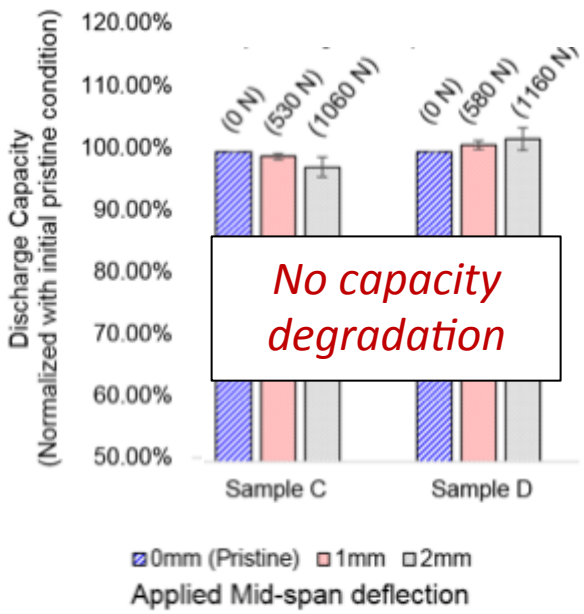
Mechanical/Electrochemical Test Results

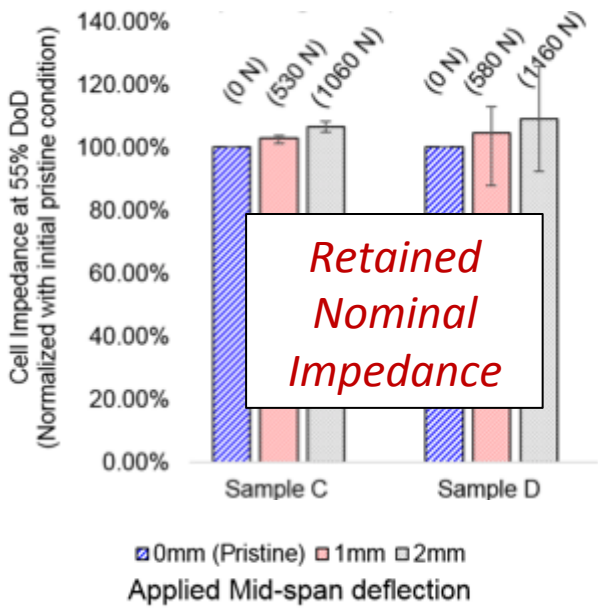


Under load, measure:

- Capacity
- DC Impedance

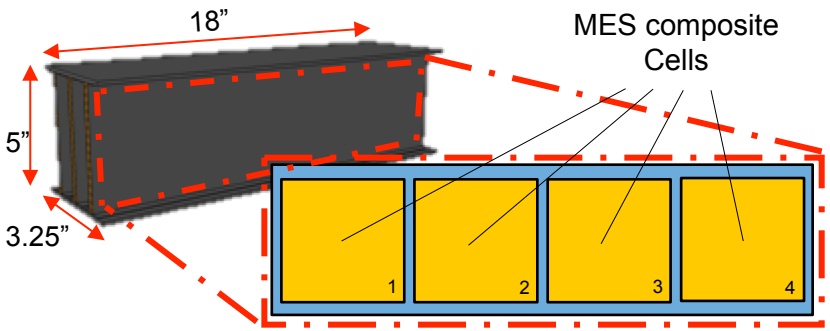
No electrical degradation under >1000N bending load





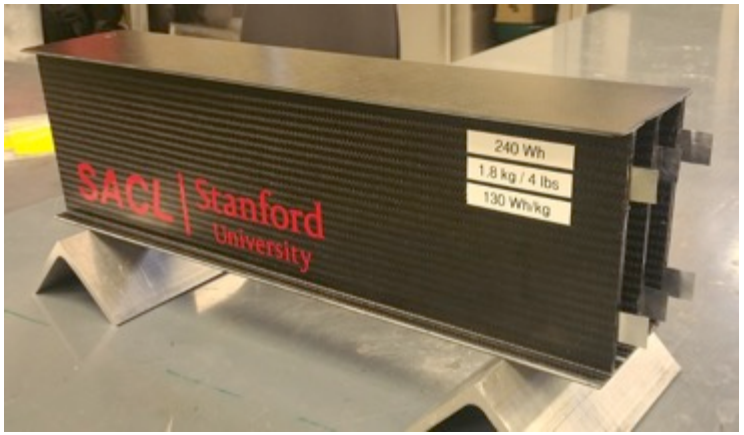
Scalability – Multi-Cell Module

3S4P 240Wh Module



Specifications	Values
Weight	1.8 kg
Configuration	3S4P (12 cells)
Energy Capacity	240 Wh
Grav. Energy Density	130 Wh/kg
Vol. Energy Density	250 Wh/L (50 Wh/L (with channels))

load carrying capacity > 6000lbs



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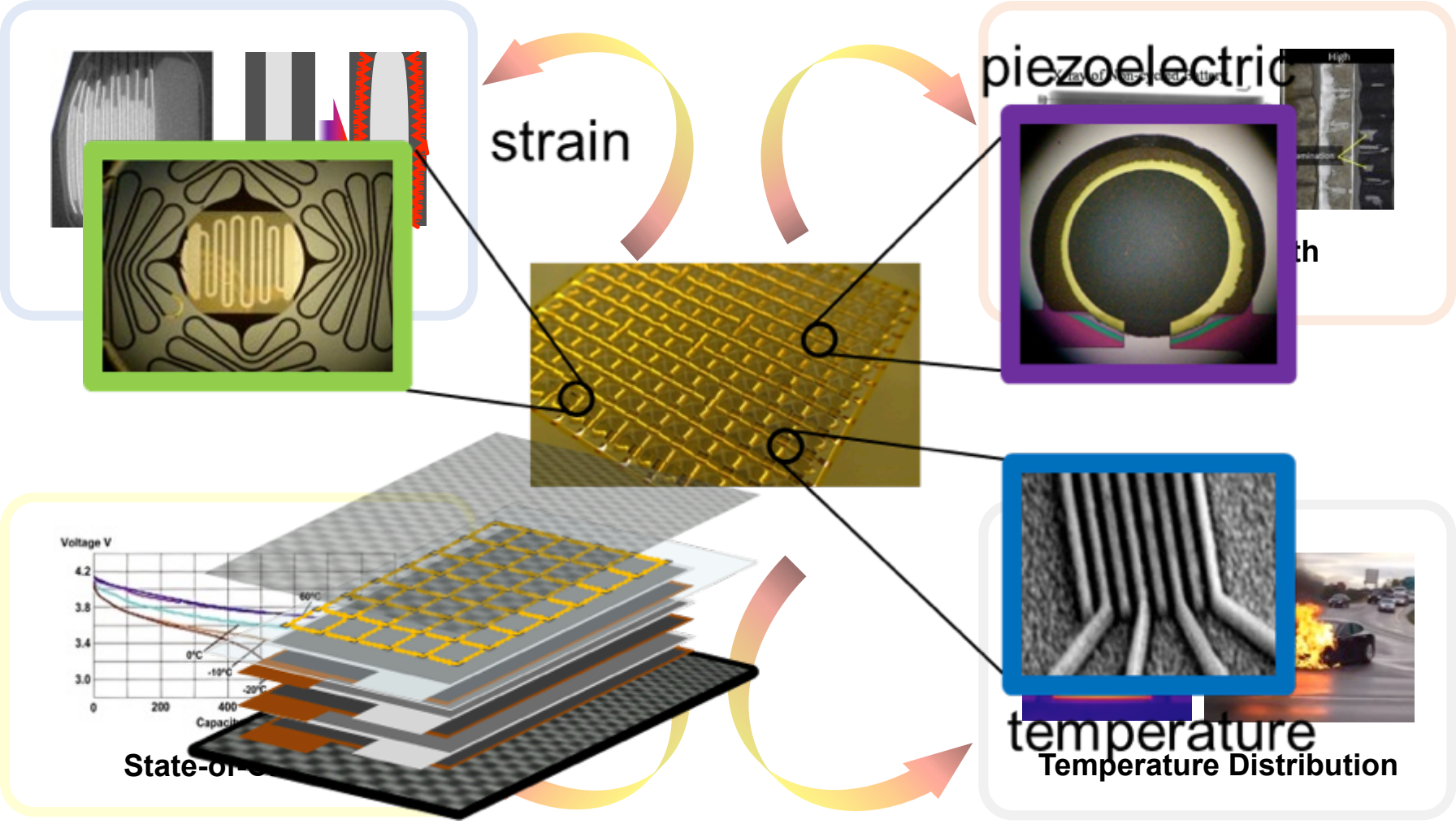

Battery & Structural Health Monitoring System

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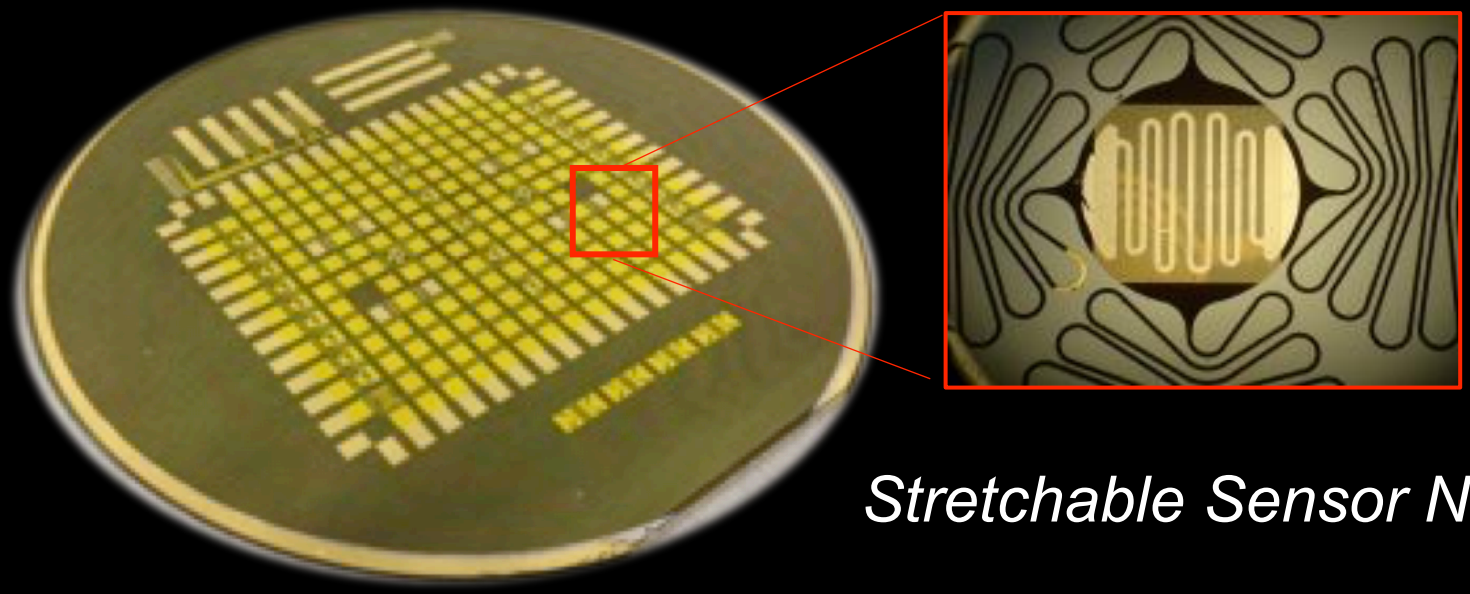


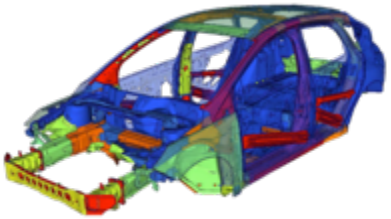
Stretchable Sensor Network

T2M Activities:

Way Forward & Potential Collaborations

Scalable, reliable production methods

Automotive Battery Standards and Requirements

- Automotive Battery Standard Testing – USABC, UN, IEC..

Automotive Testing Standards