

## DOE SBIR-STTR SUCCESS STORY



nano-structured capacitor element developed by Sigma Technologies

### Electric Vehicle Spinoff

Using funding from the Office of Electricity (OE) for the development of high voltage capacitors for DC-Link applications, Sigma Technologies found commercial application in the electric vehicle market. Per the Vehicle Technology Office in the Office of Energy Efficiency and Renewable Energy:

*“with their immense potential for increasing the country's energy security, economic vitality, and quality of life, plug-in electric vehicles (PEVs) – including plug-in hybrid electric and all-electric vehicles – will play a key role in the country's transportation future.”<sup>1</sup>*

Dr. Imre Gyuk, whose OE program funded the Sigma Technologies work, explains further, “To succeed in our ambitious goals for energy storage and electric vehicle cost reduction, we will need to improve our power electronics in size, cost, and efficiency.” Dr. Gyuk continued, “SBIR offers an excellent avenue to recognize technological innovations and bring them to commercialization.”

Among the many bumps in the road to realize OE’s and VTO’s lofty aims, lies the lowly capacitor – a device for storing electrical energy that was initially developed in the 1700s. Fast forward multiple centuries to the mid-2010s, intervening capacitor innovations were yet not adequate

<sup>1</sup> VTO website: <https://www.energy.gov/eere/vehicles/batteries-charging-and-electric-vehicles>

### Sigma Technologies, International Fast Facts

#### **PHASE III SUCCESS**

Spinout company  
PolyCharge America, Inc.

#### **IMPACT**

Millions of dollars of third-party investment and significant revenue generation.

#### **PROGRAM OFFICE**

Office of Electricity (OE)

#### **COMPANY CONTACT**

Angelo Yializis, CEO

<https://www.sigmalabs.com/>

<https://www.polycharge.com/>

for the highly advanced energy density, voltage and operating temperature requirements for electric vehicles (EVs).

Serendipitously, in 2013, OE put out an SBIR topic for High Voltage Capacitors for DC-Link Applications. The application of choice for Sigma Technologies was EVs. At that time, Sigma Technologies' CEO Angelo Yializis was working on a Department of Defense (DOD) SBIR for the development of nanostructured dielectric materials when a colleague mentioned the OE capacitor opportunity. Yializis saw the opportunity to take concepts that he developed earlier in his early career at GE – that had been applied to appliances and defense businesses – and to apply those nanostructured dielectric materials concepts to improve the performance of capacitors in EVs. Yializis comments, "They were looking to push forward a bit of the technology for electric vehicles. An EV has a battery, an inverter, and the motor. The inverter converts the DC voltage to three phases to run the motor. One of the largest and, I'd say, least reliable components is the capacitor. That was 50-year-old technology and they wanted to replace that."



*Angelo Yializis  
CEO Sigma  
Technologies*

There was rough road ahead. Yializis had only 3 days to write the application from the time he heard about the funding opportunity from his colleague. Yializis tells the story, "In the end, I stayed in the office for 36 hours straight to finish that application" Sigma Technologies' application was awarded for "A high energy density capacitor with superior life and reliability that is a key component of power semiconductor inverter circuits, used in automotive hybrid and electric vehicles ...." Leveraging the funding from the Phase I and Phase II grants, Yializis and team in fact developed a nanostructured dielectric material for use in an EV capacitor. In collaboration Delphi Automotive, a tier 1 automotive industry OEM, the Sigma team developed capacitors that met and surpassed the EV requirements.

The SBIR/STTR program at DOE and throughout the federal government has multiple measures for Phase III program success: sales revenues, employees hired, intellectual property generated, licensing revenues, and capital invested. Additionally, sometimes overlooked, spinoffs can be considered a success when evaluated by the above criteria. In this context, a spinoff is a type of corporate realignment involving the separation of a division or product line to form a new independent corporation. Yializis recalls, "The technology was really good. With the grant partners, we thought, why don't we just spin it out, create a new company and go into large scale production." PolyCharge America Inc. was spun out to manufacture capacitors for electric drive inverters. This is the third spinoff of Sigma Technologies, and by far the largest commercial opportunity given the size and growth of the electric vehicle market.

As of 2022, PolyCharge is generating sales revenue by selling limited numbers of EV capacitors to the DOD for electrification of a fighting vehicle. But don't underestimate the company – they have global ambitions. In addition to the units being sold to the DOD, PolyCharge is producing

numerous samples for global EV manufacturers. PolyCharge is working with several highly recognizable names in the automotive industry on 5-year programs to get the new EV capacitor technology into electric vehicles across the globe. To finance the growth of the company, PolyCharge has raised multiple rounds of private financing, the latest of which, per PitchBook.com data, values the company at \$100M.

Looking in the rearview, Yializis says, “We've been around for over 30 years. Early on we tried to get more SBIRs when the company was very young. SBIRs really helped with technology development funding.” Since 1993, Sigma Technologies has received 77 SBIR awards from DOD, DOE, Environmental Protection Agency (EPA), National Aeronautics and Space Administration (NASA) and National Science Foundation (NSF) totaling almost \$17.5 million. Based on those awards, Sigma has had multiple Phase III successes in addition to PolyCharge. Those successes include the aforementioned spinoff and innovations in thermal management materials, energy storage products, fibrous and porous materials, barrier films and specialty pigments which account for millions of dollars of private sector revenue.

And at 72 years old, Yializis shows no signs of hitting the breaks. Yializis is still CEO of Sigma Technologies, which is headquartered outside of Tucson, AZ, employing 30 people. Yializis is also CEO of the new spinoff PolyCharge America Inc. Yializis concludes, “I love solving meaningful, difficult problems and deploying useful innovations. I am always tinkering with this or that – even my golf swing.”