



## Who Is The Graphene Duo?



Dean Bor Z. Jang

As a little boy who was born and raised in southern Taiwan, and half the world away, Bor Z. Jang was fascinated and inspired by President Kennedy's audacious vision to land on the moon. Over a half century ago, the President eloquently argued for increased funding for a moon landing in front of a joint session of Congress in May 1961. In July 1969, Apollo 11 landed on the moon. This was the spark that motivated and instilled Dr. Jang's passion for science and technology. He chose chemistry and physics as specialties in

his high school and collegiate years. He was so good at it and, upon graduating with a Physics major from National Central University in Taiwan, he earned a full scholarship and stipend to study at a premier institution, Massachusetts Institute of Technology, in materials science and engineering.

With a Ph.D. degree in Materials Science in hand in 1982, he was ready to change the world. The next stop was at Auburn University, Alabama. For two decades, Professor Jang steadily advanced from Assistant Professor to full Professor. His meritorious awards included the Professor of the Year and the Alumni Professorship. During the period of 1991 – 1992, Professor Jang was elected as a Fulbright scholar working as a visiting professor in the Department of Materials Science and Metallurgy at the University of Cambridge, UK. He authored a book named "Advanced Polymer Composites: Principles and Applications" and has over 200 scientific publications.

Professor Jang later moved to Fargo and served as the Walter Booth Distinguished Professor and Head of the Department of Mechanical Engineering and Applied Mechanics at North Dakota State University during 2002 – 2005. In 2005, Professor Jang was promoted to Dean of College of Engineering and Computer Science at the Wright State University (2005 – 2010). In 2015, he retired from academic career and focuses his immense intellect to pursue graphene commercialization and applications.

As he contributed impactfully in academe, Professor Jang has an innate entrepreneurial passion and is a brilliant inventor. In 1997, Dr. Jang formed a start-up company called Nanotek Instrument, Inc. to pursue nanomaterials and devices. Dr. Jang pioneered the field of 3D printing. He is the co-inventor of



3D printing of continuous fiber composite, 3D printing of food objects (e.g. cakes), 3D color printing, and 3D printing of electronic components.

As a scholar, he asked a fundamental question “how do we get desirable properties of carbon nanotubes, a premium nanomaterial, at commercial useable costs?” After working with his research team at Nanotek for several years on this topic, his team filed the world’s first patent application on nano graphene in 2002 to answer that question. It was two years ahead of the two Nobel Laureates, who won the 2010 Nobel Physics Prize presumably for the reason of discovering graphene in 2004.



Dr. Aruna Zhamu

In his early days in Fargo, North Dakota, a chance meeting with Dr. Aruna Zhamu forged a long standing partnership that altered the trajectory of graphene development. In the frozen tundra of Fargo, Dr. Zhamu served as a postdoctoral researcher in the field of nanocomposites. In 2006, Dr. Jang invited Dr. Zhamu to become President and Chief Technology Officer of Nanotek Instruments, Inc. Upon arrival in Dayton, Ohio, they cofounded Angstrom Materials, LLC in 2007. And, at the height of the financial crisis, this abyss was shone by a unique “black light” far away from the financial centers. They seeded the vision of the Graphene Valley – the world’s largest graphene and graphene-related high-tech ecosystem in the heart of the Midwest. At The Entrepreneurs Center of Dayton, the reindustrialization of Dayton has begun. In a short period, the dynamic duo literally exploded into the graphene patent landscape, who had applied for over 200 US patents with many more in the pipeline. Specifically for Dr. Zhamu, she singularly dominates this category as the most prolific woman inventor in the world. (The runner up has less than 150 US patents.) The pair presciently focuses on two categories – mass production methods and graphene-enhanced applications.

In mass-scale graphene production (kilotons per year), the duo are pioneers in several breakthrough technologies. Their research team invented the most important and scalable graphene production processes, such as chemical method (2004), electrochemical method (2006), supercritical fluid method (2006), liquid phase exfoliation method (2007), direct microwave method (2011), and high-shear method (2013). These processes are the most widely practiced technologies for graphene



production around the world. They converted these intellectual assets into production. The team established the world's first single-layer graphene mass production facility in 2013; by supplying the world with premium graphene materials, the Zhamu & Jang team defined, altered and accelerated the trajectory of the worldwide graphene industry.

In graphene-enhanced applications, which create a demand pull through, the Zhamu & Jang team invented broad arrays of technology platforms. They include graphene-enhanced composites (2002), graphene-containing fuel cells (2004), graphene-based supercapacitors (2006), graphene-enabled batteries (2007), graphene-enhanced thermal films or heat-spreaders (2007), graphene-based inks (2008), graphene-enhanced lubricants and grease (2009), and graphene-enhanced tires (2009).

As entrepreneurs, the dynamic duo made many sacrifices and delayed gratifications. There were many lean years but rich with the dream and belief that graphenes will be world-changing and life-changing enablers. During the past decade, from the first mass production of pristine graphene in 2013 to breakthrough performance of lithium-ion batteries, their contributions were gaining global recognition. In July 2015, Dr. Jang was interviewed by the Wealth Magazine, a highly influential business publication in Taiwan. Soon after, he was coined the "Father of Graphene" in Asia. In cyber space, he is fondly called the "GrapheneKid". Parenthetically, he crucifies his colleagues for calling him the "Father of Graphene". It sounds too old, he says.

In the following quarter, the duo's reputation skyrocketed. Across the globe, well-heeled investors came calling who want to be on the early wave of this material revolution. Without investment bankers, the pair raised over \$25 million by themselves. One significant investment was by the Western & Southern Financial Group. A sagacious chairman at W&S decided the investment was strategic to his portfolio. He closed the round in rapid fashion. Mr. Barrett brought not only funds but strong business practices and governance to the team. With sufficient funding and more smartly crafted deals, Angstrom was folded into a holding company called the Global Graphene Group. It houses Nanotek Instruments, Angstrom Materials, Honeycomb Battery, Angstrom Energy and other strategic business units. From 2015 to 2017, the global headcount doubled to 74. Twenty-eight percent are Ph.D.'s. The duo is on their way to dominate the graphene space, building world-class teams, and reinventing advanced manufacturing in Dayton. A decade post founding of Angstrom, they reached the consciousness of business executives.



They rang in the dawn of graphene and kicked off a new material revolution. Graphene-enabled products are coming out of the labs and into the living rooms.

From a company cultural perspective, Dean Jang is an educator at heart, especially for Science, Technology, Engineering, and Mathematics (STEM). In his “free” time, he promotes and encourages children to choose science and technology as their profession. He taps into their innate curiosity and creativity. He demonstrates, poignantly, that careers in science and engineering are fun and forever young. For G<sup>3</sup> visitors, these elements are palpable in the hallways of Graphene Valley. For the nation, Dean Jang sees strength in STEM as foundational to its vitality and economic stability.

To sum up, Dean Jang and Dr. Zhamu are at the intersection of frontier of science, business sustainability, and philanthropic endeavor. At Global Graphene Group, every day, the employees come into work and push the boundaries of graphene. They dive in, exploring what this wonder material can do, how far it can go, what it can accomplish. But, really, what they are truly pursuing goes much deeper than any scientific discovery made in a lab. What they are seeking are the breakthroughs and inventions that can only be found when people rally around a common purpose and goal. And for Global Graphene Group, that is to make the world a better place.

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## **Selected Accomplishments of the Graphene Duo:**

### **Dean Bor Z. Jang:**

- Pioneered graphene technology; world’s first to discover graphene in 2002.
- Recognized as world’s No. 1 graphene inventor (>200 graphene-related US patents + numerous international patents).
- Co-invented 150+ US patents on battery, fuel cell, and supercapacitor.
- Co-founded Nanotek Instruments, Inc., Angstrom Materials, Inc., Angstrom Energy Co., Honeycomb Battery Co., and Global Graphene Group.
- Granted a total of 380+ US patents and 40+ PCTs (international patents).



## Dr. Aruna Zhamu:

- Awarded 285 US patents. The only woman scientist in the world that has more than 150 US patents.
- Recognized as the world's No. 2 graphene inventor (> 200 graphene-related US patents).
- Co-invented graphene-enabled high-capacity anodes, high-capacity cathodes, non-flammable electrolytes, supercapacitors, surface-mediated cells (SMC), lithium-sulfur battery (next-generation battery for EV), thermal films, lubricants/grease, and tires.
- Co-founded Angstrom Materials, Inc., Angstrom Energy Co., Honeycomb Battery Co. and Global Graphene Group.
- Led Angstrom Materials, Inc. to become world's No. 1 producer of single-layer graphene oxide.

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## **About Global Graphene Group (G<sup>3</sup>)**

G<sup>3</sup> is the holding company for four subsidiaries: **Nanotek Instruments**, founded in 1997, is the Intellectual Property arm of G<sup>3</sup> with more than 200 U.S. patents. **Angstrom Materials**, founded in 2007, is the largest volume producer of graphene globally. It is focused on high volume production of graphene raw materials, enhanced thermal interface materials (films, pastes, inks), and nanocomposite products (both thermoplastics and thermosets). **Honeycomb Battery**, founded in 2015, is focused on commercializing next generation lithium ion battery electrodes, batteries enhanced with graphene, and improved battery manufacturing processes. **Angstrom Energy** was founded in 2016 and is focusing on commercializing graphene-enhanced silicon anode materials.

## **FOR IMMEDIATE RELEASE**

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