



Dr. Paul Jaewoo Kim with Naieel Team Members

Naieel – Providing the best service in the BNNT business as well as its applications for the next generation

“In the near future, our roles in the BNNT business as well as its industrial applications will be critical. We will develop the business strongly based on our unique and exclusive technical abilities.”

In contrast to carbon nanotubes (CNT), boron nitride nanotubes (BNNT) have a different chemistry and functionality, including higher thermal stability, electrical insulation, neutron absorption capability, and piezoelectricity, etc. while they also have similar analogous structures and impressive mechanical properties. BNNT will be a key nanomaterial for the fourth industrial revolution, employed for IT/IoT, space/nuclear/defense, biomedical, and energy/environment because of its remarkable material properties. As a result, the industry is anticipated to expand quickly and witness the development of BNNT applications in everything from electronics to aerospace engineering.

Naieel Technology is one such company, which is a provider of industrial scale of BNNT and the application technologies. The company supplies BNNT for various applications, including cosmic radiation shielding for the space industry, heat dissipation for the IT and electronics industries,

performance enhancement for Li-ion battery, as well as biomedical.

The company was established by researchers from the Korea Atomic Energy Research Institute on September 9, 2015, for the commercialization of BNNT. Dr. Paul Jaewoo Kim, CEO of Naieel, spoke exclusively to The Silicon Review about how his company is considered as a global leader in advanced energy and environmental technology based on BNNT for the next generation.

A Look Back: How it all began

Founder Dr. Jaewoo Kim was formerly a principal researcher at the Korea Atomic Energy Research Institute until 2021. When he was there, he had spent many years developing the BNNT synthesis technology. Based on his research outcomes, he concluded that mass manufacturing of BNNT would be feasible, thus in 2015 he founded Naieel Technology to market the BNNT nanomaterial. He now asserts that Naieel's BNNT production

capacity is the finest and biggest in the world, and that he can easily grow it over several tens of tons as the industrial demand arises.

Naieel's New Technology Is Making the Rounds

The use of BNNT leads to economic growth by increasing the viability of renewable energy sources such as use for the H₂ oxidation catalyst for fuel cells. They are also light and strong similarly to carbon nanotubes, while thermally durable and shielding radiations, making them a prime candidate for future applications in aerospace engineering. Naieel's investment will open further researches for BNNT, and bring this material into the new era of advanced technologies not yet available.

Currently, Naieel is primarily focused on the development of thermal interface materials for packaging of high-end CPUs and GPUs especially used for AI, 5G/6G, whose thermal conductivity is higher than 10W/mK when used with BNNT. Additionally, Naieel's

About | Dr. Paul Jaewoo Kim

Dr. Paul Jaewoo Kim is the **CEO** and **CTO** of Naieel. He received a PhD degree in Nuclear Engineering from the University of Missouri-Columbia in 2000. Since then, he has been working at the Korea Atomic Energy Research Institute until August 2021. Now he is solely focusing on his work on the BNNT business. Also, he was appointed as a professor at the University of Science and Technology in Daejeon, South Korea, during 2015–2018.

Along with BNNT technology, Dr. Jaewoo Kim handed two innovations he created while working at KAERI to the businesses. In addition to working on both academic and commercial R&D projects, he has so far published more than 50 articles in peer-reviewed journals and applied for or registered more than 60 patents.

most innovative use of BNNT is an additive for separators as well as electrolytes for the Li-ion batteries. Comparing to the electrolytes without BNNT, the Li-ion conductivity can be increased up to 2.5 times with BNNT. In addition, this will improve the C-rate performance and cycle retention, coulombic efficiency, as well as the specific capacity of the batteries. Also, BNNT can be utilized as a catalyst for hydrogen oxidation in the fuel cell anode and for the cracking of methane and ammonia, which lowers operating temperature and energy use.

Naieel's BNNT Products

NanoBorNT-80 and NanoBorNT-90 are two types of white-colored BNNT powder products that Naieel now manufactures using a novel and distinctive thermochemical reaction technique created by its scientists and engineers. In this context, NanoBorNT means 'born into nano' and 'nano boron nitride tubes'. The numbers (80 and 90) refer to the weight percentage of BNNT, while the remaining portion is made up of h-BN particles and flakes, whose chemical purity is nearly 100% (h-

BN and BNNT are both of the same chemical nature; the only difference is that h-BN is a disk-type particle while BNNT is nanotubes). With diameter distribution of 30–50 nm and the lengths of 5–10 μm, and needle-like and open-ended structures, BNNT can be dispersed in any medium more readily than the other nanomaterials such as CNT.

Naieel's Customer-Centric Approach: A Vision, Aligned

Naieel's primary attention is on its clients and customers. Naieel provides the cheapest BNNT in the entire world, making Naieel's BNNT very useful for both their exceptional quality and industrial applications. Additionally, the Naieel offers technical support for the dispersion of BNNT in various medium, while they also supply surface treated BNNT products and BNNT dispersants in a variety of solvents and/or polymeric resins.

Roadmap

"We are currently working on BNNT raw nanomaterials, which are

significant. But from the perspective of company valuation, this is restricted to raising the company valuation. Due to the fact that this product is not yet available globally, we are working hard to create 1) semiconductors packaging thermal interface materials for high-end CPU and GPU needed for AI/5G. The moment we introduce this materials, it will completely alter the market for products of this kind. 2) BNNT additive for Li-ion battery electrolytes and separators," said Dr. Paul Jaewoo Kim.

"Our responsibilities in the BNNT sector and its industrial applications will be crucial in the near future. Based on our distinctive and exclusive technical skills, we will vigorously build the business. By embedding thermal interface materials onto semiconductors, for example, we are attempting to offer solutions that do not yet exist. Currently, we might be the only company offering the solution for the industrial-scale BNNT production. The entire Naieel team works closely together and is fervently committed to changing the industrial paradigm using BNNT technology," concluded Dr. Kim.

"Naieel's BNNT products are renowned for their superior quality as well as their industrial applications, based on our needle-like and open-ended cylindrical BNNT with almost pure in BN chemical form."