Award Recipient: QuantumSphere, Inc.

Award Description

Frost & Sullivan's Technology Innovation Award is bestowed upon a company (or individual) that has carried out new research; which has resulted in innovation(s) that have or are expected to bring significant contributions to the industry in terms of adoption, change, and competitive posture. This Award recognizes the quality and depth of a company's research and development program as well as the vision and risk-taking that enabled it to undertake such an endeavor.

Research Methodology

To choose the Award recipient, Frost & Sullivan's analyst team tracks innovation in key hi-tech markets. The selection process includes primary participant interviews and extensive primary and secondary research via the bottom-up approach. The analyst team shortlists candidates on the basis of a set of qualitative and quantitative measurements. The analyst also considers the pace of research and technology innovation and the significance or potential relevance of the innovation to the overall industry. The ultimate Award recipient is chosen after a thorough evaluation of this research.

Measurement Criteria

In addition to the methodology described above, there are specific criteria used to determine the final rankings. The recipient of this Award has excelled based on one or more of the following criteria:

- Significance of the innovation(s) in the industry, and across industries (if applicable)
- Potential of the products of innovation(s) to become industry standard(s)
- Competitive advantage of innovation vis-à-vis other related ones
- Impact (or potential impact) of innovation(s) on company or industry mindshare and/or company bottom line
- Breadth of intellectual property related to the innovation(s), i.e. patents, scientific publications, papers in peer reviewed journals.

2005 Metallic Nanopowder Technologies Technology Innovation of the Year Award

Award Recipient: QuantumSphere, Inc.

Frost & Sullivan's 2005 Technology Innovation Of The Year Award in the field of metallic nanopowder technologies goes to QuantumSphere, Inc. in recognition of the company's development of a novel automated vapor-deposition based process technology for the production of high-quality metallic nanopowders and alloys. These materials could ultimately replace expensive platinum as the main catalyst in a variety of fuel cells, in addition to being used in 'traditional' areas such as batteries, emissions reduction, chemical synthesis, and conductive inks.

Santa Ana, California-based QuantumSphere is employing an automated vapor-deposition based process technology to produce a wide variety of nano scale metals and high-performance catalysts such as QSI-Nano™ iron, silver, copper, nickel, cobalt, manganese, and a variety of nano metal alloys. These magnetic, conductive, and catalytic materials could be used across a number of end user segments including energy, defense, transportation, electronics, and other markets demanding advanced material applications.

QuantumSphere's bottom-up process combines conventional gas-phase condensation methods with the firm's own intellectual property, to develop high-performance nano scale catalysts with a controlled particle size and oxide shell thickness, narrow and uniform distribution, and low levels of agglomeration. Resistance heating is used to first liquefy and then vaporize the metal precursor, which is then exposed to the laminar flow of inert gasses to condense the metal into spherical nanoparticles meeting specification requirements. The use of resistance heating and vapor condensation helps produce higher purity nano metals with reduced degrees of agglomeration.

QuantumSphere's process is fully automated and highly scalable, governed by a proprietary software system monitoring and controlling up to 23 different metrics on the production process. This confers key advantages to QuantumSphere's production

process: the high degree of control over a wide range of parameters provides repeatability, allowing the particle size distribution, oxide shell thickness, and particle characteristics to be maintained across small batches and large continuous production runs. It also makes QuantumSphere's process more flexible, allowing production to be adapted and modified to meet specialized, application-specific needs generated by different customers or partners. Also each process can be easily optimized to meet defined requirements for oxide shell thickness, consistent particle size and uniform distribution. This capability is significant given the largely customized, case-by-case, application-centric nature of nanomaterials. This process is environmentally friendly and generates nano scale metals and catalysts that are safer to handle and more easily dispersed in a variety of solutions and polymers.

QuantumSphere has three vapor condensation process reactors, and a fourth one is expected to come online in December 2005. A small bench top reactor is dedicated to the development of new nanometals and alloys. One small plant reactor is intended for research, with low production rates averaging around a few grams per day; the second is capable of producing a few kilograms per day; and new systems due online in December will be capable of production rates varying between one and two hundred kilograms per month. These numbers vary according to the material being produced, with high production rates being possible for metals such as copper and silver, dropping significantly for materials like cobalt and nickel, with higher boiling points. The company has established intellectual property in key processes related to the production, collection, and dispersion of nanomaterials, for instance, in terms of the control of the laminar gas flow around the particles to produce nanopowders of particular size, purity and oxide shell thickness. The company also has intellectual property filed on nano-enabled devices for applications in the battery and fuel cell markets.

QuantumSphere's efforts have also focused on increasing strength to weight ratios for composites, and on increasing the toughness and conductivity of these nanomaterials. Preliminary work has also been done in conjunction with research at laboratories, universities, and other companies to develop magnetic coatings and conductive inks. The firm's research and development team has focused on micro fuel cell devices and batteries for portable power applications, and in the area of hydrogen generation and storage for renewable energy. A proprietary nano manganese catalyst was developed in 2005 and recently validated as an excellent catalyst material for use in primary Zinc/air batteries (see the company's website for additional details www.qsinano.com). These advanced materials could also help replace expensive platinum as a catalyst in a variety of fuel cell devices and potentially help spur the growth of this emerging portable power market.

In conclusion, Frost & Sullivan's Excellence in Technology Award recognizes QuantumSphere, Inc.'s contributions towards developing high performance metallic nanopowders via a novel automated gas phase condensation process technology.