2008 European Technology Innovation Award

Organic Spintronics

The 2008 Frost & Sullivan European Technology Innovation Award in the field of spintronics for sensor applications goes to Organic Spintronics in recognition of the company's unique thin film fabrication technology that exploits the benefits offered by organic semiconductors as more suitable alternatives for transport of spin when compared to inorganic semiconductors. With its active research and development (R&D) in the field, Organic Spintronics is on the forefront of spintronics-based innovation for sensing applications as well as thin film fabrication.

A spin-off company that was founded in 2003 by researchers of the Italian National Research Council (CNR), Institute I.S.M.N. (Institute for Nanostructured Materials Studies, C.N.R., Bologna Division), Organic Spintronics s.r.l., based in Bologna, Italy, focuses on materials and thin film deposition techniques for organic semiconductors along the concepts dictated by spin-based electronics. The technologies so developed would enable developments in spintronic-based organic memories, logic circuits, as well as improve efficiencies of organic light emitting diode (OLED)-based displays. Spintronics is an emerging technology space that uses an electron's spin polarization to store and manipulate information rather than the charge of the carrier that conventional electronics use. A basic spin based device is a two terminal device like the spin valve in which the receptivity depends on the applied magnetic field. Controlling the spin polarization in a device is one of the requirements of this technology. The current roadblocks that spin-based devices face include spin injection and spin detection.

Most of the research in this area concentrates on using inorganic semiconductors such as gallium arsenide, which have not been suitable for room temperature operations. The company had taken a different approach by using organic semiconductors in order to overcome the challenges faced in this domain. This had enabled the company in achieving room temperature operation. Due to their low-scattering rate in comparison to inorganic semiconductors, organic semiconductors are more feasible toward the transport of spin polarization. Devices are fabricated using organic semiconductors and half metallic ferromagnets (colossal magnetoresistance [CMR] materials)
The discovery of organic spintronics represents a major breakthrough in the field of spintronics and is likely to enable real world implementation of devices such as spin-based sensors. The benefits would be manifold and extend to sensitivity, size, and power consumption of sensor systems. The technology could also find application in memory elements, magnetic sensors, and logic elements such as spin field effect transistors (FETs). The company also develops organic Knudsen cells to enable thin film deposition of organic semiconductors that are finding greater use in plastic or flexible electronics and optoelectronics, industries that are poised to open up huge markets in the coming years.

In line with these developments, the company has developed a pulsed plasma deposition (PPD) system for the deposition of organic thin films. Thin film technologies are challenged by the complexities involved in engineering and production. The deposition of thin films using PPD technique is by ablation of a target material using a fast pulse of electrons (100 ns) and deposition of the material onto the substrate. The PPD system has a broad range of deposition rates and operation vacuum conditions that enable its use in diverse conditions of growth of thin films.

The uniqueness of the system is the ability to transfer the chemical composition of the target to the film and in this way the most complex thin films may be fabricated. This comes with the advantage of low-operating temperatures that are conducive for the deposition on plastic substrates such as polyethylene terephthalate (PET). In comparison to pulsed laser deposition (PLD), PPD offers enhanced benefits in terms of beam power density, repetition rate, and in particular in power efficiency while being simple in construction. It is economically suitable to be scaled to large area systems and also consumes lesser power. Organic Spintronics has developed a wide area deposition PPD system that uses multiple guns for the fabrication of thin films on 4 in. substrates. The development of wider area roll to roll systems are under way. Organic Spintronics also establishes thin film deposition processes on demand and posses a wide IP portfolio on PPD- based thin film fabrication processes.

The company has presented several research papers including “Organic/Inorganic Hybrid Spin Valve: a Novel Approach to Spintronics,” ”Room temperature spin polarized injection in organic semiconductor," and “Structure of the coatings onto ceramic cutting tools deposited by pulsed high energy density plasma” among others for over a decade. The driving force behind the company’s success is its CEO Carlo Taliani, a world renowned scientist and Director of Research at ISMN-Bo,CNR, Bologna with over five papers that have received over 1,895 citations. Organic Spintronics s.r.l. owns intellectual property rights for the use of organic semiconductors in combination with CMR materials (US Patent n° 6 325 914 - dec. 2001).

In recognition of the company’s discovery of organic spintronics by combining organic semiconductors along with ferromagnetic materials as well as its pioneering efforts in the development of organic spin-based processes and systems, Frost & Sullivan confers the 2008 European Technology Innovation Award in spintronics for sensors on Organic Spintronics.

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 analysts also consider 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 innovations.
- Impact (or potential impact) of innovation(s) on company or industry mind share and/or company bottom line.
- Breadth of intellectual property related to the innovation(s), that is, patents, scientific publications, and papers in peer-reviewed journals.

About Best Practices

Frost & Sullivan Best Practices Awards recognize companies in a variety of regional and global markets for demonstrating outstanding achievement and superior performance in areas such as leadership, technological innovation, customer service, and strategic product development. Industry analysts compare market participants and measure performance through in-depth interviews, analysis, and extensive secondary research in order to identify best practices in the industry.

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