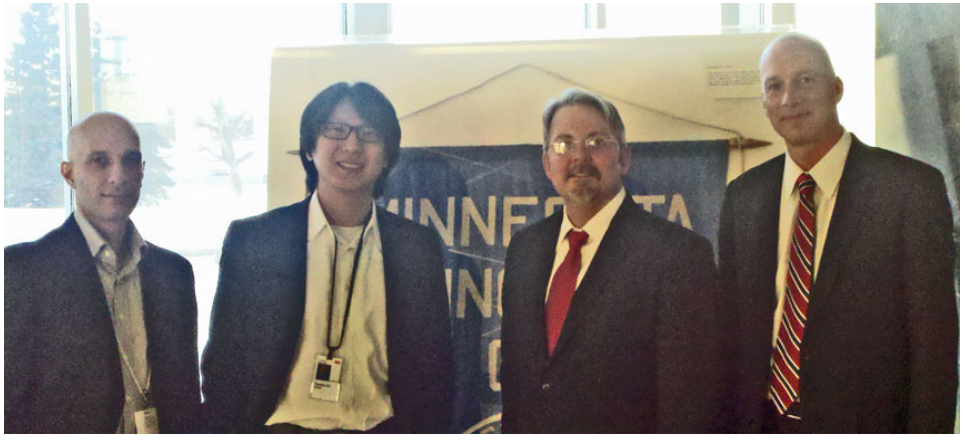
GoNano technologies, inc.

Volume 3, Issue 1 Summer 2011

3M Corporation invests in GoNano

GoNano Technologies and St Paul-based 3M, through its New Ventures Business, recently closed a Series A investment round.



Pictured from right to left: Joseph Risico, 3M General Counsel; Young-jin Choi, 3M Ventures; Tim Kinkeade & Dr. Grant Norton, GoNano

"GoNano Technologies' unique technology platform offers significant performance improvements for chemical flow reactors that benefit from large surface areas" Stefan Gabriel, president, 3M New Ventures, said. "The combination of this potentially game-changing nanomaterial

In This Issue

Events

- Jun 5-10: North American Catalysis Society
- Jun 13-16: TechConnect World 2011, Boston, MA
- Jun 27-30: Carbon Capture and Utilization

with our technology platforms further stimulates disruptive innovation and creates new business opportunities in the catalytic conversion space for 3M."

"3M is recognized as a global technology leader in the industry," said Tim Kinkeade, Chief Executive Officer of GoNano Technologies Inc. "We are excited to partner with a company that shares our strong commitment to innovation and we look forward to working with 3M to advance transformational products and processes based on the Nanospring platform."

Forward Looking Statements

This news release contains forward-looking statements that involve risks, uncertainties and assumptions. All statements other than statements of historical facts are statements that could be deemed forward-looking statements, including any statements of the future plans, strategies and objectives of management. Other risks, uncertainties and assumptions are described under "Risk Factors" in Part I, Item 1A of the Annual Report on Form 10-K for its fiscal year ended December 31, 2010 and in Part II, Item 1A in the Quarterly Reports on 10-Q for the fiscal quarter ended September 30, 2010. 3M assumes no obligation and does not intend to update these forward-looking statements.

Nanospring is a trademark of GoNano Technologies Inc.

About 3M

3M captures the spark of new ideas and transforms them into thousands of ingenious products. Our culture of creative collaboration inspires a never-ending stream of powerful technologies that make life better. 3M is the innovation company that never stops inventing. With $27 billion in sales, 3M employs about 80,000 people worldwide and has

Conference, Dijon, France
- Aug 15-18: IEEE Nano2011, Portland, OR

operations in more than 65 countries. For more information, visit www.3M.com or follow @3MNews on Twitter.

Top

GoNano develops Nanospring™ Catalytic Converters with NSF Funding

With the support of the National Science Foundation, GoNano Technologies is applying Nanospring technology to catalytic converters to make more efficient use of Platinum Group Metals (PGMs) in the short term and combine multiple emission control functions into a single device in the long term. Current diesel catalytic converter technology oxidizes both carbon monoxide and hydrocarbon emissions and, with a separate device, captures and reduces carbon particulate matter (PM) and nitrogen oxide (NOx). GoNano received a Small Business Innovative Research (SBIR) Phase 1 grant from the National Science Foundation in the amount of $149,000 to demonstrate the technical feasibility of a novel four-way catalytic converter for diesel engines.

GoNano Technologies' innovative approach to next-generation catalytic converters combines its high-surface area Nanospring technology with industry-standard monoliths. GoNano Technologies can uniformly coat the internal surfaces of three-dimensional structures, such as catalytic converter ceramic (shown in the series of images in Figure 1) and stainless steel monoliths with high surface area Nanosprings (for gasoline/diesel mobile engines the monolith is typically cordierite and for stationary applications the monolith is metal).

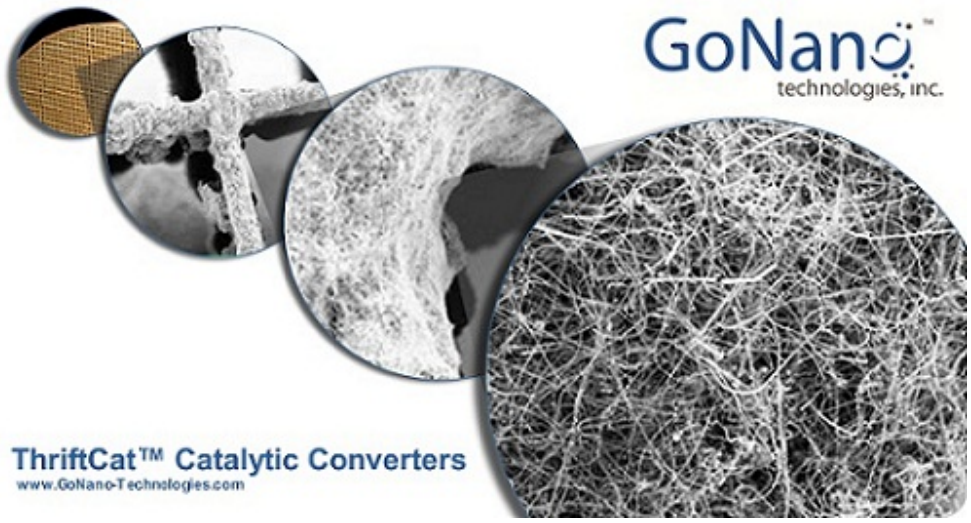


Figure 1: Progressively magnified images of Nanospring-coated cordierite wall

Catalytic Converters - Current Technology:

For decades, pollution from automobile emissions has been an area of concern because of the associated environmental impact coupled with the growth in the world vehicle fleet. Catalytic converters enjoyed widespread adoption in the US starting in 1975 following their introduction by the Engelhard Corporation. Since then they have become standard in exhaust pollution control. One of the most significant milestones in catalytic converter technology was the development of the three-way catalyst (TWC) in 1981.

Figure 2 shows an early (c. 1984) example of a so-called dual-bed catalytic converter. The active PGM catalyst is supported on, and is also within, an oxide wash-coat, which is applied onto the walls of the ceramic honeycomb monolith. While the TWC technology has been incredibly successful in the gasoline market it suffers from a number of limitations. Probably the most significant limitations are the low activity of the catalyst at low temperatures (i.e., at engine start-up),

inability to reduce NO_X in lean burn engines such as diesel and high cost. The latter is due in large part to the PGMs, which serve as the active catalyst.

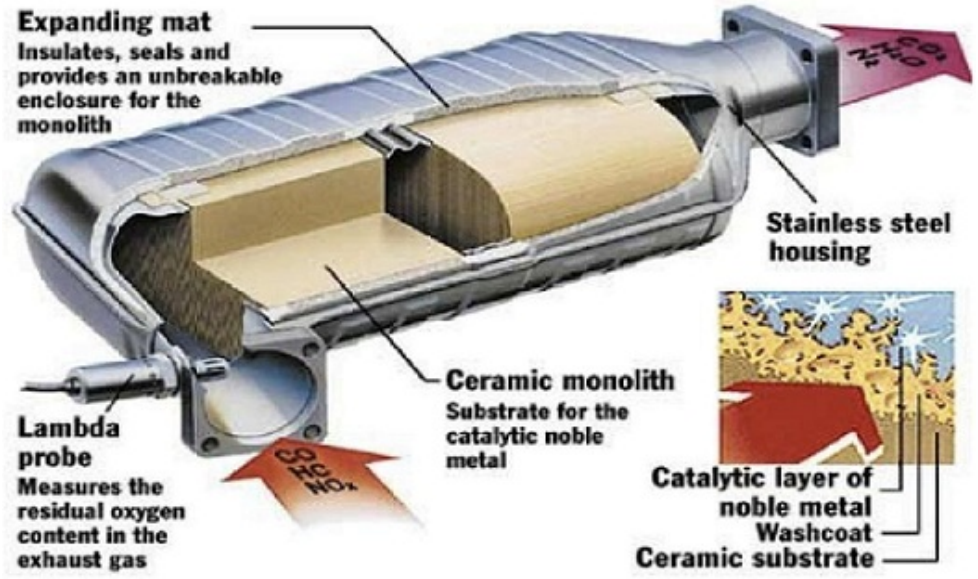


Figure 2: Schematic of a dual-bed catalytic converter. The insert shows an enlarged representation of the surface of a ceramic monolith, with wash-coat and PGM catalyst layer.

The activity of a catalytic converter is, in part, a function of the particle size of the PGM catalyst. As the catalyst particles age they agglomerate, or sinter. Eventually the particles become large enough that they become catalytically inactive and are blown out of the catalytic converter by the exhaust gas flow. Further compounding the issues with the current approach, much of the total surface area of the catalyst particles is not accessible, i.e., it is buried in the wash-coat (and not exposed to the exhaust gas stream). This represents an inherent inefficiency, and increased cost, in the use of the PGMs.

Innovation:

Engineering the morphology of the inner surface of the

monolith is a novel approach that impacts catalytic converters through:

- Increased reactivity by way of higher exposed surface area – resulting in lower PGM loadings and associated cost savings.
- Decreased light-off temperature through smaller particle size – light off represents the time it takes for the catalyst to work and is partially a function of heat. A significant amount of emissions are untreated as a result of a slow light off, when the engine has not warmed up the catalyst.
- Improved durability and lifetime through increased thermal stability – the surface chemistry of the Nanosprings combined with their unique morphology has demonstrated exceptional particle stability characteristics.

Following the deposition of Nanosprings into the monolith, the Nanospring surface is functionalized with the active catalyst. Standard catalytic converters contain a proprietary formulation of PGMs and oxides. Preliminary aging data has demonstrated enhanced particle stability, which reduces the sintering or agglomeration of PGM particles and extends the life of the catalytic converter. Industry standard PGM loadings, which represent roughly 80% of the cost of the device, are typically increased to enable a greater lifetime. Nanosprings, without any coating, have demonstrated thermal stability up to 1050°C thus exceeding the requirements for diesel catalytic converters.

“Pending changes in the regulatory environment have given way to an opportunity in the catalytic converter space and particulate mitigation. GoNano’s ability to coat a wide variety of substrates, coupled with the capacity to coat silica Nanosprings with a full spectrum of active catalysts, provides

an ideal technology fit for integration into the catalytic converter market" said Tim Kinkeade, CEO of GoNano Technologies. "The ability to integrate nanomaterials with conventionally manufactured bulk scale products cannot be overrated. It offers a significant advantage in introducing nanomaterials into existing products and markets."

Market Opportunity & Drivers:

The vehicle emissions catalyst market was $1.3 billion in 2008, excluding the cost of Platinum Group Metals. For that same year the stationary emissions catalyst market was $1.2 billion. Projections indicate that the catalytic converter market for newly manufactured heavy-duty diesel engines will grow from $1 billion in 2009 to $3 billion in 2012 (Source: Johnson Matthey). Larger markets include sales to light-duty truck manufacturers as well as an emerging retrofit market for older diesels built prior to 2006.

EPA 2010 Regulations state that PM emissions cannot exceed 0.01 g/brake horsepower hour (g/bhp-h). Nitrogen oxide emissions cannot exceed 0.20 g/bhp-h and non-methane hydrocarbon (NMHC) emissions cannot exceed 0.14 g/bhp-h. Implementation of these regulatory requirements creates opportunities for technology development. Additionally, the sulfur content in on-highway diesel fuel cannot exceed 15 ppm (down from the previous 500 ppm). Over ten million operating diesel engines in the U.S. do not meet EPA's new clean diesel standards.

Driving the market opportunity further, in February 2010, the EPA provided a final ruling on National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines (RICE NESHAP). This ruling affects existing stationary diesel engines. The affected stationary diesel engines must comply with CO emission limits or must be fitted with emission controls, such as diesel oxidation

catalysts, to reduce CO emissions by 70%.

According to the EPA, 180,000 of the 900,000 diesel engines impacted by the passage of RICE NESHAP will require diesel oxidation catalyst. The majority of the retrofitting will occur during 2012 and early 2013 in anticipation of RICE NESHAP compliance enforcement which will go into effect in May of 2013.

Figure 3(a) shows a standard cordierite catalytic converter monolith where the internal walls have been coated with a matrix of silica Nanosprings. Higher magnification images of a fractured cross section are shown in Figure 3(b). The Nanosprings uniformly coat the internal walls of the ceramic and extend along the length of the ceramic. The matrix thickness is approximately 100µm and with a surface area of more than 350 m^2 per gram Nanosprings offer significantly higher accessible surface areas than traditional alumina based wash-coats.

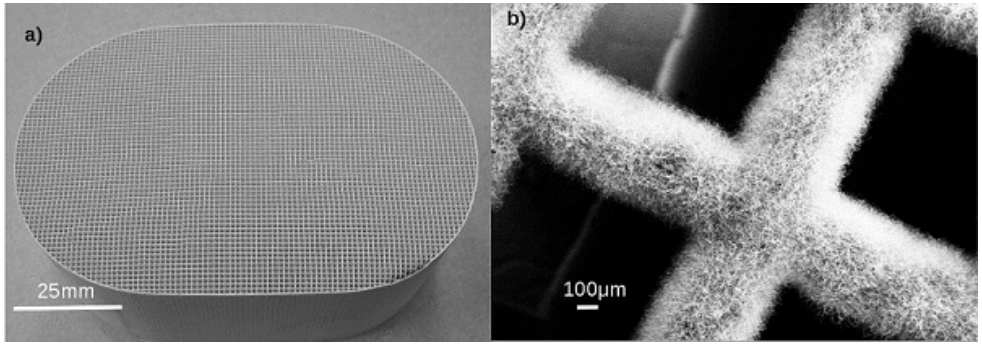


Figure 3: a) Nanospring-coated cordierite wall in plan view b) Higher magnification image of the Nanospring-coated cordierite

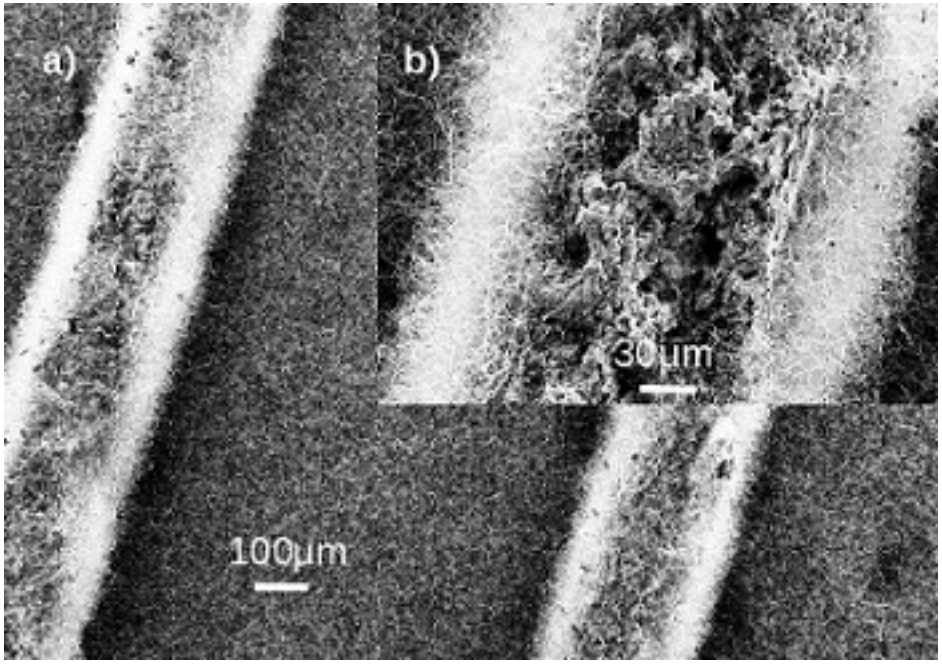


Figure 4: a) Cross section electron microscope image of Nanospring-coated cordierite b) Higher magnification image of the Nanospring-coated cordierite

Top

Employee Profile: Nanospring's "coolness" excites GoNano's Chemist Tim Cantrell

An outdoors man in the research team, Timothy “Tim” Cantrell lists backpacking, hiking, mountaineering, and snowshoeing as his passion when he is not developing materials at GoNano Technologies. He plans to climb Mt. Hood in Oregon (elev. 3,429 m) and Mt. Rainier in Washington (elev. 4,392) this year. Tim is also learning to play the guitar and likes board games in his limited spare time.

Tim joined "Team GoNano" in 2008 soon after graduation with BS and MS degrees in Chemistry from the University of Idaho. Born and raised on a farm in Wendell, Idaho, a small town in south-central Idaho, Tim “kind of fell into Chemistry because I ended up being a natural at it. I really liked science when I was growing up and I really enjoyed my college chemistry courses. I gave a Chemistry career a shot and 12 years later here I am.” said Tim enthusiastically when asked about his career decision to pursue Chemistry.

Tim is excited to be working with Nanosprings: "they are efficient to produce, easy to functionalize the surface, and generally have some of the “coolest” properties I have seen in nanomaterials (i.e., suppression of particle ripening)” he says. Working at GoNano Technologies also allows Tim to stay in a small town, which he appreciates.

Tim's MS thesis was in two parts: a section on coating Nanosprings with metal nanoparticles and an organometallic section dealing with constrained ring aluminocene and stannocene compounds. Between his college and professional years, Tim has written or contributed to several technical

About GoNano

GoNano Technologies manufactures high-surface area silica Nanospring™ nanomaterials for pollution control, catalysis, composites and sensory technologies. For more information on how GoNano Technologies can enhance your product, or to become a strategic partner, call 208.892.2000 or email sales@gonano-9.com

articles and co-holds three patents. Tim currently is the Principal Investigator in the NSF-funded project to develop Carbon Capture & Recycle technology.

At GoNano, we believe Tim is an all-around cool Chemist and a great team player.

Top

GoNano in the news and events

- National Science Foundation Catalytic Converter grant press release covered in several on-line and print media, most notably Green Car Congress and Humanitarian News
- Jun 5-10: Timothy Cantrell to present a poster on Liquid Phase Hydrogenation at the North American Catalysis Society, Detroit, MI
- Jun 13-16: Dr. Grant Norton and Dr. Giancarlo Corti to present papers at TechConnect World 2011, Boston, MA
- Jun 27-30: Dr. Grant Norton to present a poster on Carbon Capture and Recycling at 11th International Conference on Carbon Capture and Utilization Conference, Dijon, France
- Aug 15-18: Dr. Giancarlo Corti to present a paper at the IEEE Nano2011, Portland, OR

Top

121 W. Sweet Avenue, Suite 115, Moscow, ID 83843 p 208.892-2000 f208.892.2001 sales@gonano-9.com