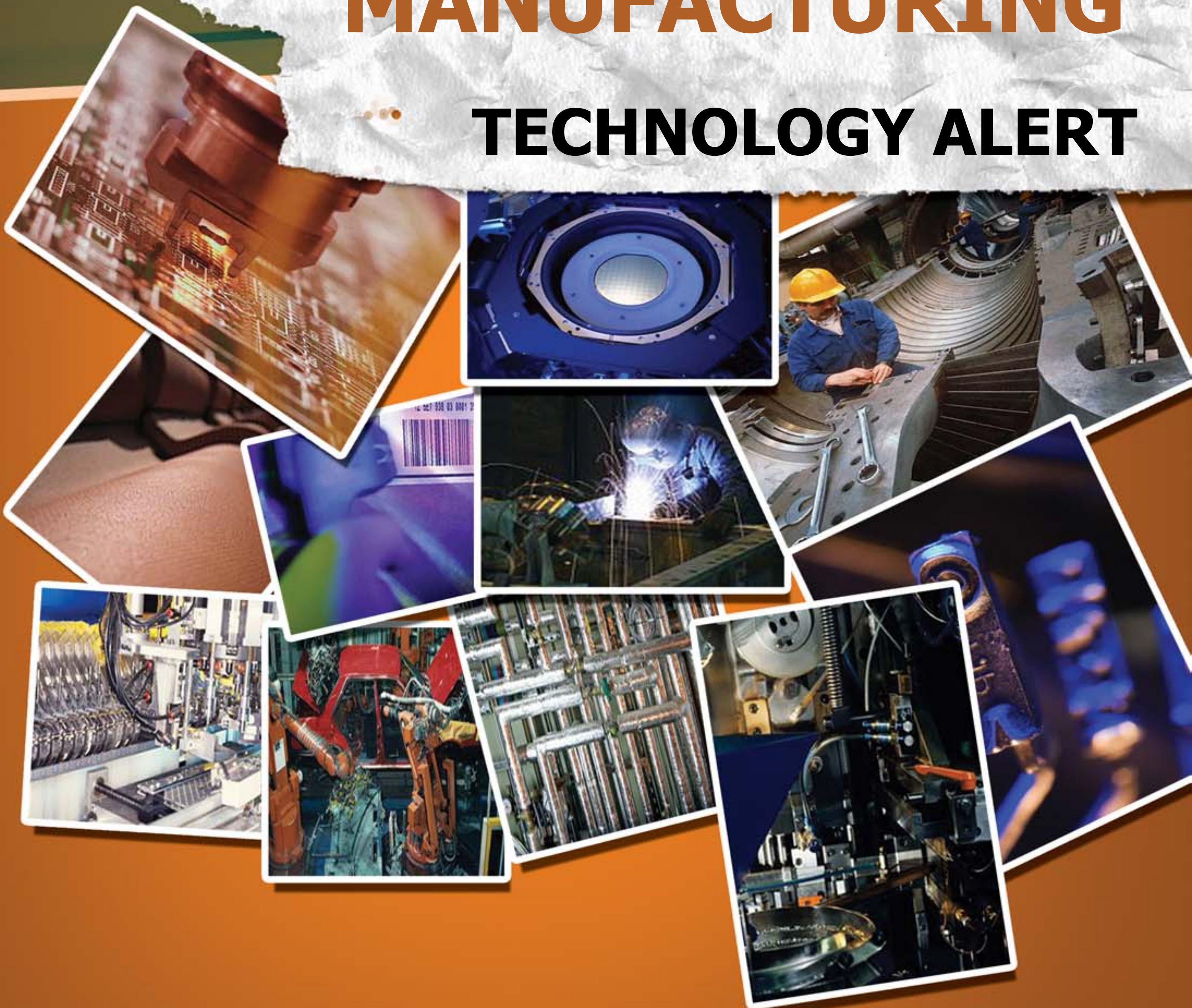
TECHNICAL INSIGHTS

ADVANCED MANUFACTURING

TECHNOLOGY ALERT



23rd January 2015

1. PROCESS TO MANUFACTURE TITANIUM POWDER AT SIGNIFICANTLY LOW COST

Metals and alloys are now being used in three-dimensional (3D) printing of various components. Titanium powder is one such metal, and participants in sectors such as automotive, aerospace, healthcare, and so on have been trying to adopt this metal for manufacturing their products. However, the high costs associated with the manufacture of titanium have restrained its adoption.

Metalysis, a metals manufacturing company based in Rotherham, UK, has developed a novel process for manufacturing titanium powder at a significantly low cost. The company believes that this invention would lead to the use of titanium powder in a wide range of components produced using additive layer manufacturing in the automotive, aerospace and defense industries. The Knoll process is the conventional manufacturing process currently used in the industry for manufacturing titanium powder. In this process, the metal sponge is first produced which is then processed into ingot billets before being melted in the form of a bar, which is finally atomized into powder. A disadvantage of this conventional process is that it is expensive; moreover, it is labor extensive. Metalysis has developed a manufacturing process that addresses these issues. In this process, rutile sand is converted directly into titanium using the electrolysis process. This makes it less expensive and also environment friendly when compared to the conventional processes. This new process has also created newer opportunities for the use of this metal in mass production of lower-value components. The company has also collaborated with the Mercury Centre in the Department of Materials at the University of Sheffield, UK, to use the Renishaw 3D printer to test the feasibility of the titanium components using additive layer manufacturing. As this process is conducted in a solid state, new materials having different densities and melting points can be developed. The metal powders that are created by this process from Metalysis can also be engineered to achieve the particle size and distribution that is required for a wide range of applications in different sectors. This unique titanium powder developed from rutile sand can be used for the manufacture of automotive parts. The company believes that this titanium powder developed using this novel process can be adopted by a wide range of industries for use in their components by 2016.

The advantage of this novel process is that it employs rutile sand, which is found abundantly and is also less expensive for manufacturing titanium powder. This radical cost reduction with the use of titanium powder can lead to expansion of the application areas as well as products that can be manufactured using titanium. Due to the above-mentioned advantages, the titanium powder developed using this process has the potential to be significantly adopted in a large number of industrial sectors. This can also lead to newer products where titanium powder has not been employed before due to its high cost.

Details: Kartik Rao, Director of Business Development, Metalysis, Unit 2, Farfield Park, Manvers Way Wath upon Dearne, Rotherham, South Yorkshire, S63 5DB, UK. E-mail: kartik.rao@metalysis.com. Phone: +44-0-1709-872-111. URL: http://www.metalysis.com.

2. NOVEL ARCHITECTURE FOR DEVELOPMENT OF MODULAR ROBOTS

Researchers are continuously developing newer robotic technologies in order to make robots more sustainable and efficient. Now, there is a novel innovation in the architecture to develop modular robots that could be modified according to the needs of the user.

Researchers from Carnegie Mellon University, USA, have developed a robot that demonstrates that modular robots could be easily reconfigured to meet the specific needs of the user. This robot has been developed by the researchers using a modular system consisting of various modules, such as force sensing feet, wheels and tank-like threads. According to the researchers, the development of a modular system allows the robot to be easily reconfigured and programmable. In addition to the above-mentioned capability, the researchers believe that it would be possible to build robots that are robust, flexible, and inexpensive. The modular technology has the potential to increase development in the field of industrial robots and also produce novel kinds of robots. The researchers have received sponsorship from the Defense Advanced Research Projects Agency, USA through its Maximum Mobility and Manipulation (M3) program. The M3 program focuses on novel ways to design and develop robots with enhanced capabilities which would in turn allow them to manipulate objects and move in natural environments. This novel robot developed by the Carnegie Mellon University researchers is said to be demonstrated at the Robotics challenge which is to be organized by the DARPA in California on the 5th and 6th of June, 2015. Some of the applications for this robot are urban search and rescue, archaeological exploration, inspection of power plants and refineries. This novel robot consists of six legs which have a reach of 30 cm which are connected to a rectangular body. The weight of the entire robot is estimated to be around 8 kilograms. The architecture of this robot is easily programmable for controlling robots with a wide variety of configurations, thereby making it feasible for developing robots based on the needs of the user. The interfaces used in this modular architecture of the robot enable the designers to focus on the particular capabilities without having to change the entire system of the robot. One of the other key factors of the modular architecture is the development of elastic actuators (a motor consisting of spring in series with the output shaft). This spring not only helps in protecting the motor from high impacts but also allows the actuators to measure and regulate the force which is exerted by and on the actuator.

Some of the advantages of this robot are that it demonstrates novel ways to develop modular robots that could be configured to meet the various specific needs of users and develop inexpensive robots for a wide range of application sectors. With all the above-mentioned advantages and capabilities, this robot has potential to be adopted on a large scale.

Details: Byron G Spice, Director of Media Relations, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213. Phone: 412-268-9068. E-mail:bspice@andrew.cmu.edu. URL: www.cmu.edu.

3. BRUSHLESS MOTORS FOR FUEL DELIVERY MODULES IN AUTOMOBILES

Fuel pumps that are being used in automobiles employ a fuel delivery module (FDM) consisting of various components for the filtration and pumping of gasoline to the vehicle's engine at a constant pressure and flow rate from the fuel tank. FDM systems consist of a reservoir assembly for maintaining the fuel supply at the pump inlet and also other components such as pressure regulators, sensors, electrical and hydraulic connections.

A novel FDM that has been developed by Delphi Power Train Systems, Michigan, USA, employs a brushless (BL) motor in the assembly of the pump and also consists of an integrated controller in order to provide the electrical communication for the motor. The BL motors are said to be more efficient than the conventional motors and also the controller in this novel FDM provides a closed loop speed control. These two features in the FDM provide significant improvements in terms of the power consumed and reduction in the carbon dioxide that is emitted. Other key capabilities, such as durability and reliability, are also increased in this FDM due to the magnetic coupling that is present between the stators of the motor and rotor, which eliminates the contact between them, thereby reducing wear and tear. The integrated controller used in this FDM also provides the diagnostics of the pump, such as the sensor signal processing circuit present within the assembly of the tank and the additional performance factors of the system.

Reduction in noise and sensorless motor speed measurements are some of the other benefits that are obtained using the BL controller. The BL controller also compensates for the variations in parameters of the pump and time induced drift. The performance of the system is optimized by minimizing the distance from the integrated FDM assembly and the BL pump. A control algorithm is also tuned to the design of and applications of the pump. Factors, such as voltage, drive currents, controller temperature, and speed of the motor are also monitored by the controller present in the FDM. The system shuts down automatically when the variations in the above-mentioned parameters are more than the acceptable limit, thereby significantly reducing the risk of damage. Engineers have used robust techniques and statistical tools in order to derive the ideal solution for meeting the torque, speed, pressure, and flow requirements. The ideal combination was derived from various tests that were carried out by them in the laboratory using motor assemblies. The company is looking to incorporate this novel FDM in all its power train systems by 2016.

The advantages of this FDM are that it provides improvements in terms of the power used and also reduces the level of carbon dioxide emitted. Due to the above-mentioned advantages, engines using this FDM technology could be adopted on a significant scale.

Details: Lynn Kier, Senior Communications Manager, Delphi Power Train Systems, 5725 Delphi Drive, Troy, Michigan. Phone: 248-732 -0615. E-mail: lynn.kier@delphi.com. URL: www.delphi.com.

4. PATENT ANALYSIS OF CO-INJECTION MOLDING PROCESS

In the co-injection molding process, two resins or polymers are injected simultaneously into the same mold. This the most commonly used process among the various multi-material molding processes. This type of molding process is employed for a wide range of applications in different industrial sectors. Some of the commonly used materials in co-injection molding processes are polyamides, nylon, polyacetal, polycarbonate, polyesters, polysulfone, polyethersulfone, polypropylene, polyethylene, ABS, PBT, polybenzimidazole, and polyamide-imides.

One of the latest patents in the co-injection molding process, US 8663514 B2, is assigned to Knoll, Inc., It pertains to a novel product (for example, a chair) produced from co-injection molding using gas-assist.

The Procter & Gamble Company has filed a patent (WO2013126667 A1) pertaining to a high thermal conductivity co-injection molding system. Some of the other key patents for this manufacturing process were filed by Illinois Tool Works Inc., (WO2010054188 A1), pertaining to a co-injection molding system that incorporates two or more injection gates feeding a common mold cavity and Johnson Control S.P.A (US 6475413 B1) for a process and device for co-injection molding of multilayer products.

Title	Publication Date/ Publication Number	Assignee	Inventor	Abstract
Gas-assisted co-injection molded chair	March 4, 2014/ US 8663514 B2	Knoll, Inc.	Adam Daniel DESKEVICH, Hendrik Richard VAN HEKKEN, Richard A. Wolfe	The invention is directed to an article made from co-injection molding using gas-assist. The article has an inner material and an outer material. The inner material has a blowing agent uniformly distributed throughout the inner material. The outer material surrounds the inner material. The use of the blowing agent in the inner material produces a repeatable and consistent structure, as the blowing agent is uniformly activated through the product. The use of the gas-assist the heat and pressure associated with the blowing agent is allowed to out gas, thereby insuring that the finished molded chair or other item is aesthetically pleasing while providing increased strength and reduced weight compared to traditional plastic chairs formed with known methods.
High thermal conductivity co-injection molding system	August 29, 2013/ WO 2013126667 A1	The Procter & Gamble Company	Charles John Berg, Gene Michael Altonen, Ralph Edwin Neufarth, Emily Charlotte Boswell, Joseph Moncrief LAYMAN	A low constant pressure co-injection molding machine forms molded parts by injecting molten thermoplastic material into a mold cavity at low constant pressures of 6,000 psi and lower. As a result, the low constant pressure injection molding machine includes a mold formed of easily machineable material that is less costly and faster to manufacture than typical injection molds. Co-injection of thin-walled parts having an L/T ratio >100, with embedded sustainable materials, such as polylactic acid (PLA), starch, post-consumer recyclables (PCR), and post- industrial recyclables (PIR) isolated from surfaces by barrier layers of leach-resistant material having a thickness less than 0.5mm, is possible. The co-injection molding machine is provided with a screw comprising a material having an average thermal conductivity of more than 30 BTU/HR FT °F.
Co-injection molding process and parts formed thereby	May 14, 2010/ WO 2010054188 A1	Illinois Tool Works Inc.	Frank J. Villari, Glenn Poyer	A co-injection molding system incorporating two or more injection gates feeding a common mold cavity to provide multiple cores surrounded by a skin material within the final finished part. An injection molding system including one or more slug traps disposed along the conveyance path between the injection nozzle and the injection gate and/or at remote portions of the mold cavity to collect and retain vestigial slugs that may form at the injector nozzle and/or at injector gates.

Coinjection molding cooled shooting pot cylinder and injection moulding method	September 30, 2009/ EP 1765563 B1	Husky Injection Molding Systems Ltd.	Abdeslam Bouti	Coinjection molding shooting pot cooling apparatus and method are configured to cool a shooting pot cylinder which, in combination with a shooting pot piston, injects a melt through a coinjection nozzle having at least two melt channels ending at the same gate. Preferably, a heat sink sleeve is disposed to contact an outer surface of a rear portion of the shooting pot cylinder. The heat sink sleeve is configured to remove sufficient heat from the shooting pot cylinder to increase the viscosity of the melt therein, thus reducing melt leakage between the shooting pot piston and the shooting pot cylinder.
Co-injection apparatus for injection molding	December 13, 2005/ US 6974556 B2	Bemis Manufacturing Company	Peter F. Bemis, Steven J. Kolste, Daniel Cykana, Stephen R. Fiacchino, Michael P. O'Grady	A co-injection nozzle pin (20) having downstream and upstream ends. The nozzle pin has therein a central bore (30) including an upstream end (32) adapted to communicate with a first material and a downstream end (34) exiting at the downstream end of the pin. The nozzle pin also has an outer surface (36) including a first portion (38) having a diameter D1, a second portion (40) having a diameter D2, wherein D2 is less than D1 and the first portion is rearward of the second portion. The pin further includes a channel (46) spiralling around the outer surface and being adapted to communicate with a second material. The channel (46) includes a first segment (52) defined in the first portion (38) of the outer surface and increasing in depth as it travels in a downstream direction and a second segment (54) defined in the second portion (40) of the outer surface and decreasing in depth as it travels in a downstream direction.
Co-injection manifold for injection molding	August 16, 2005/ CA 2147458 C	Peter F. Bemis, Daniel Cykana, Loren C. Albrecht, Gerald W. Swart	Peter F. Bemis, Daniel Cykana, Loren C. Albrecht, Gerald W. Swart, Bemis Manufacturing Company,	Injection molding apparatus comprising a platen, a die which is fixed to the platen and which defines a mold cavity having an inlet, a co-injection manifold mounted on the platen, the manifold including a nozzle housing having forward and rearward ends, the nozzle housing including an outlet which is located adjacent the forward end and which communicates with the mold cavity inlet, first and second spaced apart inlets which are located adjacent the rearward end and which are respectively adapted to communicate with first and second injection nozzles, a first passageway communicating between the first inlet and the outlet, and a second passageway communicating between the second inlet and the outlet.

Process and device for co-injection molding multilayer products	November 5, 2002/ US 6475413 B1	Johnson Control S.P.A.	Dante Siano	Multilayer products, such as vehicle trim panels, provided with an external skin layer and an internal core layer are co-injection molded by injecting external material (P) through a first plurality of points of injection (3 a- 3 c) and injecting the core material (C) through a second plurality of points of injection (4 a- 4 g), the points and nozzles of injection of one material being physically distinct from those of the other material.
Use of co-injection molding to produce composite parts including a molded snowboard with metal edges	October 30, 2001/ US 6309586 B1	Jumbo Snowboards, Llc	David Colley, Joseph McRoskey, Olaf Mjelde	The present invention comprises products of and methods for producing complex shapes of composite molded articles, including snowboards, that meet or exceed the aesthetic, cost and performance requirements expected of similar non-molded composite articles. The injection molded or co-injection molded snowboard comprises a top surface and a bottom surface shaped to provide a center portion, at least one tip or tail portion and edges along the sides of the center portion, wherein the bottom surface is a substantially smooth continuous surface, the center portion is cambered away from the top surface and contains metal edges along the sides of the bottom surface center portion, the tip or tail portions are curved away from the bottom surface of the snowboard and the top surface contains binding mounts or screw threads flush mounted to secure bindings. A preferred method of constructing a snowboard comprises co-injection molding, utilizing a skin polymer with a smooth finish for exterior portions of the snowboard and a core polymer that is lighter, structurally stronger and potentially cheaper than the skin polymer for the interior of the snowboard. A mold cavity is designed for the desired shape of the snowboard. In addition to providing for the shape of the snowboard, the mold cavity is designed to accommodate inserts for side metal edges and clips to secure such edges, if necessary, and inserts for top, flush mounted binding mounts or screw threads as well as the clips to secure such mounts. An additional set of metal components may be embedded within the top surface of the snowboard to compensate for warping away from the bottom metal edges due to the polymer shrink rate. The mold cavity must be designed to accommodate inserts for securing such metal components if such components are utilized.

Co-injection molding process for manufacturing complex and lightweight parts	June 19, 2011/ US 6248289 B1	Xerox Corporation	Jay lee Schneider	A method for molding relatively complex and large shapes by a co-injection molding process which results in a significantly less expensive and lighter molded product. The process steps include first injection molding a thermoplastic material highly densified with ceramic or stainless steel particulate material to form a shell structure having a homogeneous dispersion of the ceramic or stainless steel material within its matrix and then injecting a significantly less expensive material into the core of the preformed thermoplastic/ceramic or stainless steel structure and thereafter sintering the resulting molded structure. The resultant structure is a hollow shell of highly densified ceramic or stainless steel.
The use of co-injection molding to produce composite parts including a molded snowboard with metal edges	December 21, 2000/ WO 2000076831 A1	Jumbo Snowboards Llc	David Colley, Roskey Joseph Mc, Olaf W Mjelde	Products of, and methods for producing complex shapes of composite molded articles, including snowboards are disclosed. The injection molded, or co-injection molded snowboard (60) comprises a conventional shape and contains metal edges (35, 45) along the sides of the cambered bottom surface center portion, and the top surface contains threaded hols (55) flush mounted to secure bindings. A method of constructing a snowboard is disclosed comprising co-injection molding, utilizing a skin polymer with a smooth finish for exterior portions of the snowboard and a core polymer for the interior. A mold cavity (10, 20) is designed for the desired shape of the snowboard and to accommodate inserts for side metal edges (30, 40) and inserts for binding mounts or flush-mounted threaded holes (50) on the top surface as well as the clips to secure such in the mold.

Exhibit 1 depicts patents related to the co-injection molding process.

Picture Credit: Frost & Sullivan

[Back to TOC](#)