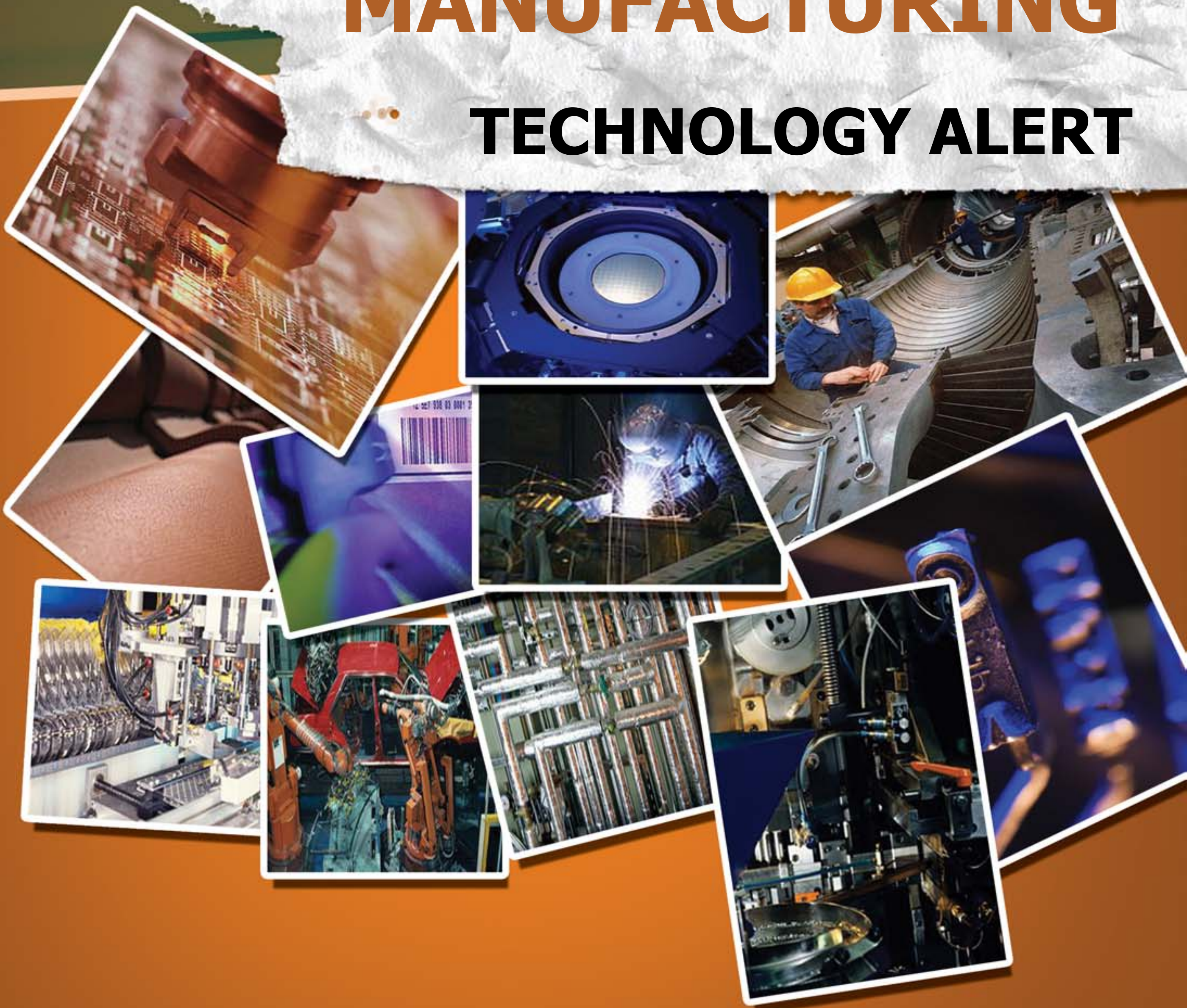
TECHNICAL INSIGHTS

ADVANCED MANUFACTURING

TECHNOLOGY ALERT



30th May 2014

1. INNOVATIVE LUBRICANT FOR ELIMINATING FRICTION

Lubricants are employed in a wide range of products that are being used in different industries. Some of the products are motors, axles, engines, and manufacturing machines. It is extremely important for lubricants to reduce the friction caused in the above mentioned products. Even though the adoption of lubricants is significantly high, there has not been much development in the recent years. A research institute in Germany, along with others, has developed an innovative lubricant that is said to reduce friction with higher efficiency than currently available lubricants.

Fraunhofer Institute for Mechanics and Materials, IWM, Germany, together with the other consortium members, has developed a substance that would result in a liquid crystalline lubricant. The mechanism used in this novel lubricant is that when the two surfaces move in opposite directions, the liquid crystals molecules between the two surfaces would align themselves thereby reducing the frictional resistance. This mechanism would enable frictionless sliding of the parts that are used in various products. In one of the tests that was carried out by the researchers of this study, the lubricant was applied between two work pieces that made of metal and the resulting friction coefficient was found to be significantly low. The liquid crystals used in the novel lubricant were seen to be well suited because of their long and thin molecules. When the lubricant containing these crystals is employed between two surfaces, the molecules are aligned parallel to each other in an ordered boundary layer. The layers are said to be stable and also capable of sliding over each other easily thereby keeping the friction to minimum. The researchers have further improved the stability of the liquid crystals by using additives and also have built a test unit comprising of laser technology to enable contact-free measurement of the extremely low-friction coefficients. The researchers used a variety of materials such as iron, copper, and ceramic in various experiments conducted with lubricant. In these experiments, the chemical mechanisms exhibited during friction and the effects of mixing different liquid crystal molecules were also observed. From these observations the prototype of this novel lubricant was developed and was tested in a sliding bearing made of iron. Currently, the researchers are developing a sliding bearing lubricated with liquid crystals for small electric motors used in alternators and wind shield wiper motors in the automotive industry.

Some of the advantages of this lubricant are that, it helps in significantly reducing friction between products that are being used in a variety of industrial sectors. This in turn would help in increasing the efficiency and longevity of the products and parts. Due to the above mentioned capabilities and advantages, this novel lubricant with liquid crystals is expected to be adopted by a range of industrial sectors once it is commercially available in the market.

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2. SIMULATION METHOD FOR ANALYZING COMPOSITE MATERIALS

Accurate measurement of the mechanical properties and behavior of an airplane composite structure has been given more importance these days since it is seen as a way to significantly reduce the need for the physical tests. This would result in the cost reduction for the manufacturers and would also enable development of better designs for airplanes. Researchers have developed a simulation strategy for predicting the mechanical behavior of composite aircraft structures that are placed under impact.

Researchers from the Madrid Institute for Advanced Studies of Materials (IMDEA), Spain, have been working on developing a simulation method for testing composite materials under the EU-funded CRASHING project (April 2014-2016). . Composite materials are made from two or more substances that are combined to form a material with novel and enhanced characteristics. These materials have been adopted on a large scale by the aerospace industry for manufacturing of various parts and products. The researchers working on this project believe that this innovative predicting method would significantly reduce the number of physical tests that are required for the certification of airplanes. It would also reduce the development time of novel structural components consisting of composite materials. This project, in addition to assessing the composite materials used in the aerospace industry, would also help in developing novel materials with potential applications in the years to come. Currently, the physical testing of composite materials is based on numerical methods. The drawback seen with these existing technologies is the accuracy of the output results that are obtained. The current development is aimed at addressing the above mentioned drawbacks and also making the prediction method suitable for a wide range of materials. The main objective of the CRASHING project is to develop a multiscale approach for assessing the physical mechanisms of damage at different points of the part length. Researchers have been able to symmetrically describe the behavior of materials at ply, laminate, and component levels. Final models of the multi scale approach are expected to be suitable for simulations of aircraft crash landing, bird strikes, ice impacts, and other common situations where the aircraft is subjected to high frequency dynamic loading. The CRASHING project has been funded by the Clean Sky Joint Technology Initiative (JTI-Clean Sky) initiative within the EU's 7th Framework Programme.

Some of the advantages of this simulation method for assessing the composite materials used in the aircraft are that it helps in significant cost reduction for the OEMs; and, by assessing the materials on impact, it would be possible to come up with aircraft designs that are safer. This simulation method has opportunities to be adopted by the manufacturers once it is commercially available.

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3. NOVEL DEVELOPMENT IN MICRO ROBOTS

Small or tiny robots are being developed for a wide range of applications in various industrial sectors. For instance, small robotic modules could be used for lifting parts and components from a storage space and transporting them to a different location. Researchers have now developed innovative small reconfigurable robotic modules that are connected to each other and can transform themselves into any shape and size. This enables the robot to connect them together and change the shape whenever there is a need.

This robot, which has been named Roombots, has been developed by Biorobotics Laboratory (BioRob) at École polytechnique fédérale de Lausanne (EPFL), Switzerland. The self-assembling robots can be bound together to make stationary objects, such as boxes, furniture, and a wall. Roombots attach with each other for forming a desired shape. The main idea behind this innovation is creating self-assembling robots that can be used in a wide range of ways. For instance, when there is a need to transport a set of parts and components on a factory floor, the robots can be made to transform into a storage box and then transport to a different location on their own. The researchers have achieved making the Roombots to move freely. The modules that are attached to the robots detach from the pile while forming structures of two or more modules. At this point of research, the robots are capable of moving around in a room with specific grid locations. Researchers are currently working on expanding this capability to larger structures with reduced energy consumption and impact with the ground surface.

Another key capability of Roombots is that they can climb walls or a step when the surface is fitted with connector plates. A single module of the robot would be able to autonomously reach any position on a plane and pass over a concave edge. When there is a need to go over a convex edge, then two modules are required. Since the modules in the robots can be tightly packed together, the robot can be easily transported and can be reconfigured to any type of structure with ease. The research is also increasing the ability of robots to attach themselves to passive elements for ease of manipulation. Currently, work is in progress for improving the overall robustness and reliability of the Roombot.

Some of the potential applications sectors envisioned for the Roombots over time include multiple assistive furniture for the elderly or those with handicaps, programmable conference rooms, satellite or space station environments, as well as industrial applications.. Since there is a wide spread adoption of robots across different industrial sectors these days, innovations such as this can furher enhance the adoption rate and also increase the application sectors.

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4. PATENT ANALYSIS OF ATOMIC HYDROGEN WELDING

Atomic hydrogen welding is a type of arc welding process where the materials are welded together by heating the work piece with an arc that is maintained between two electrodes. When the arc is maintained, a hydrogen steam is simultaneously induced into the welding zone. The hydrogen steam acts as a shielding gas; therefore, an additional welding rod is not usually used in this method of welding. In this type of welding process, the heat required for welding the materials is generated by passing the hydrogen steam through the electric arc between two inclined electrodes. The electrodes that are used in this type of welding process are usually tungsten. High temperature produced from the arc dissociates the gas molecules into atoms; thereby a large amount of heat is absorbed by hydrogen during dissociation. Once the atoms are released due to the influence of the arc, they recombine thereby forming hydrogen molecules, which release the heat that was absorbed earlier. The approximate temperature of the flame is 4000 degrees C. This heat is primarily concentrated on the recombination point of the atoms and is catalytically accelerated by the contact that is established on the metal that is being welded. This type of welding is employed when rapid welding is required; and the materials that are commonly welded using this type of welding are stainless steels and special alloys. Since the hydrogen steam acts a shield, oxidation of tungsten and electrodes is prevented. Some of the advantages of this type of welding are that the process is faster; and since the hydrogen gas acts as a shield, the need for separate flux is eliminated.

From the patents that have been exhibited, it can be seen that the research has been focused on improving the welding process, including welding of steel, filler material for welding, methods of welding composites. This would help companies using such technology to develop products that are more reliable and strong.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Welding process for processing feeding funnel	February 16, 2012/ WO 2013029352 A1	Shanghai Boiler Works Co., Ltd.,	Qiwei Huang, Yuan Yao, Geng KONG, Weiqun Zhang	A welding process for processing a feeding funnel. The funnel (1) is formed by splicing left and right funnel bodies (2, 3). The funnel bodies are each formed by splicing two steel plates (21, 22; 31, 32). The steel plates are made of Q215-A materials. The splicing of the steel plates is performed by use of acetylene oxygen welding. When the welding process is used, the heat of the flame is concentrated, so that the thin steel plate can be welded through within a short period of time. On one hand, the splicing effect is achieved, and on the other hand, defect such as steel plate melting or heat deformation is avoided, and the welding seam has desirable appearance.
Non-magnetic drill string member with non-magnetic hardfacing and method of making the same	January 27, 2012/ WO 2012103494 A2	Baker Hughes Incorporated	Jimmy W. Eason, James L. Overstreet, Travis Puzz	A method for applying a non-magnetic, abrasive, wear-resistant hardfacing material to a surface of a drill string member includes providing a non-magnetic drill string member formed of a non-magnetic material, the drill string member having an outer surface. It also includes providing a non-magnetic hardfacing precursor material comprising a plurality of non-magnetic, sintered carbide pellets and a non-magnetic matrix material; heating a portion of the non-magnetic hardfacing precursor material to a temperature above the melting point of the matrix material to melt the matrix material. It further includes applying the molten non-magnetic matrix material and the plurality of non-magnetic, sintered carbide pellets to the exterior surface of the drill string member; and solidifying the molten non-magnetic matrix material to form a layer of a non-magnetic hardfacing material having a plurality of non-magnetic, sintered carbide pellets dispersed in the hardfacing material.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
High toughness weld metals with superior ductile tearing resistance	December 12, 2011/ WO 2012102794 A1	Exxonmobil Upstream Research Company	Douglas P. Fairchild, Steven J. Ford, Hyun-Woo Jin, Mario L. Macia, Nathan E. Nissley, Adnan Ozekcin	Weld metals and methods for welding ferritic steels are provided. The weld metals have high strength and high ductile tearing resistance and are suitable for use in strain based pipelines. The weld metal contains retained austenite and has a cellular microstructure with cell walls containing lath martensite and cell interiors containing degenerate upper bainite. The weld metals are comprised of between 0.02 and 0.12 wt% carbon, between 7.50 and 14.50 wt% nickel, not greater than about 1.00 wt% manganese, not greater than about 0.30 wt% silicon, not greater than about 150 ppm oxygen, not greater than about 100 ppm sulfur, not greater than about 75 ppm phosphorus, and the balance essentially iron. Other elements may be added to enhance the properties of the weld metal. The weld metals are applied using a power source with current waveform control which produces a smooth, controlled welding arc and weld pool in the absence of CO_2 or oxygen in the shielding gas.
Austenitic welding material, and preventive maintenance method for stress corrosion cracking and preventive maintenance method for intergranular corrosion, using same	December 16, 2009/ US 8322592 B2	Japan Atomic Energy Agency, Kobelco Research Institute, Inc., Kabushiki Kaisha Kobe Seiko Sho	Kiyoshi Kiuchi, Ikuo Ioka, Chiaki Kato, Nobutoshi Maruyama, Ichiro Tsukatani, Makoto Tanabe, Jumpei Nakayama	Disclosed is an austenitic welding material which contains C: 0.01 wt % or less, Si: 0.5 wt % or less, Mn: 0.5 wt % or less, P: 0.005 wt % or less, S: 0.005 wt % or less, Ni: 15 to 40 wt %, Cr: 20 to 30 wt %, N: 0.01 wt % or less, O: 0.01 wt % or less, and the balance of Fe and inevitable impurities, wherein the content of B contained as one of the inevitable impurities in the welding material is 3 wt ppm or less, and the total content of C, P, S, N and O in the welding material is 0.02 wt % or less.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
High-entropy alloy brazing filler metal for welding TA2 and 0Cr18Ni9Ti and preparation method thereof	June 29, 2009/ CN 101590574 A	Xi'an University of Technology	Xu, JF, Qu Asia, Kai Chen	The invention discloses a high-entropy alloy brazing filler metal for welding TA2 and 0Cr18Ni9Ti. The brazing filler metal comprises the following compositions according to atomic percentage: 20 to 25 percent of Ti, 25 to 30 percent of Cu, 20 to 25 percent of Ni, 15 to 20 percent of Fe, 10 to 13 percent of Cr, 0.5 to 5 percent of Sn, 0.01 to 2 percent of In, and 0.01 to 2 percent of Ga. The invention also discloses a method for preparing a high-entropy alloy brazing filler metal foil, which comprises the following steps: smelting the compositions to obtain high-entropy master alloy in steps by a super-high vacuum arc furnace; and controlling the linear speed of a roller at 5 to 40m/s by a single roller rapid setting device to obtain the high-entropy alloy brazing filler metal foil. The high-entropy alloy brazing filler metal has good flexibility, and is convenient for processing and assembling; and in welding, the high-entropy alloy brazing filler metal has good matching property with welded metal and alloy, brazing seams have excellent corrosion resistance and are single-phase fcc solid solution tissues, and joints have high comprehensive mechanical performance.
Earth-boring tools having particle-matrix composite bodies, methods for welding particle-matrix composite bodies and methods for repairing particle-matrix composite bodies	August 4, 2008/ EP 2190618 A1	Baker Hughes Incorporated	James A. Oxford, Redd H. Smith, John H. Stevens	Methods for welding a particle-matrix composite body (120) to another body (154) and repairing particle-matrix composite bodies (120) are disclosed. Additionally, earth-boring tools (110) having a joint that includes an overlapping root portion and a weld groove having a face portion with a first bevel portion and a second bevel portion are disclosed. In some embodiments, a particle-matrix bit body (120) of an earth-boring tool (100) may be repaired by removing a damaged portion, heating the particle-matrix composite bit body (120), and forming a built-up metallic structure thereon. In other embodiments, a particle-matrix composite body (120) may be welded to a metallic body (154) by forming a joint, heating the particle-matrix composite body (120), melting a metallic filler material forming a weld bead and cooling the welded particle-matrix composite body (120), metallic filler material and metallic body (154) at a controlled rate.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
High hardness/high wear resistant iron based weld overlay materials	July 18, 2007/ WO 2008011448 A2	Daniel J Branagan, Craig M Marshall, Brian Meacham, Nanosteel Co Inc	Daniel J Branagan, Craig M Marshall, Brian Meacham	The present application relates to iron based glass forming alloys and their manufacture in powder, cored wire and stick electrode form to produce feedstock for a wide variety of weld overlay hardfacing application techniques. The alloys when welded form structures which are extremely hard and correspondingly extremely wear resistant. The novel approach of these alloys allow the replacement of conventional high hardness and wear resistant hardfacing alloys which are often composite materials made up of a binder and hard particles such as carbides, borides, borocarbides, nitrides, etc.
Tool for friction stir welding, method of welding with the same, and processed object obtained by the same	February 28, 2007/ US 7743961 B2	Furuya Metal Co., Ltd.	Tomohiro Maruko, Toshiyuki Morino, Tomoaki Miyazawa	It is an object of the invention to reduce mixing of an impurity from a friction stir welding tool, reduce abrasion of the tool, and prevent the tool from being easily broken even though an object to be worked formed by a metal or an alloy having a high melting point of 1350° C. or more is friction-stir-welded. The friction stir welding tool according to the invention can friction-stir-weld a metal or alloy having a high melting point of 1350° C. or more as an object to be worked. At least a portion brought into contact with the object to be worked has a composition containing iridium, containing rhenium, ruthenium, molybdenum, tungsten, niobium, tantalum, rhodium, or two or more of them, and containing zirconium, hafnium, lanthanum, cerium, samarium, gadolinium, scandium, yttrium, or two or more of them, and has a Micro Vickers Hardness of 300 Hv or more.

Title	Publication Date/Publication Number	Assignee	Inventor	Abstract
Gravitational and energy system	October3, 2005/ EP 1770717 A1	Mehran Keshe Tavakoli	Mehran Keshe Tavakoli	The new method and technology is described to create - under centrifugal and vacuum conditions - in presence of ionization condition - a turbulence, rotation, compressive and heating of a gaseous matter is created in a reactor by at least one central rotative magnetic field with the purpose of creating plasmatic conditions leading to the creation various magnetic fields where at least the interaction of two magnetic field would lead to the creation of at least one gravitational force phenomena. In a reactor-embodiment a chain of energetic events is created via a rotative magnetic initiation of a basic ionization of a gas (i.e. hydrogen) which then triggers a controllable chain of energy transfers (Scintillation) to the next following layer(s) of introduced gasses (i.e. He, Ne, Ar, Kr, Xe), of all other introduced elements of the periodic table (i.e. Li, Be, K, Ca, Ti, ... Pt, etc.) and/or their introduced molecule combinations (i.e. a vapor). A central colums has magnetic means to start the process. Various concepts, applications and products are disclosed, such as space travel and atomic welding .
Bearings, races and components thereof having diamond and other superhard surfaces	June 21, 2002/ EP 1552173 B1	Diamicron, Inc.	Dean C. Blackburn, Bill J. Pope, Jeffrey K Taylor, Richard H Dixon, Clayton F Gardinier, Louis M Pope, Michael A. Vail	Diamond bearings and bearing components are disclosed. Some embodiments of the bearings and bearing components (127) include polycrystalline diamond compacts (37) sintered under high pressure and high temperature to create a diamond table chemically and mechanically bonded to a substrate (35), the diamond table presenting a durable and thermally stable load bearing and articulation surface.

Exhibit 1 depicts patents related to atomic hydrogen welding.

Picture Credit: Frost & Sullivan

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