NEW TECHNOLOGY SCOUTING REPORT
No. 3/2020

IN THE NEWS TODAY:

Reported PI technologies vs products/processes (numbers correspond to news item#)

PRODUCTS & PROCESSES / PI TECHNOLOGIES	Plastics to Biofuels	Advanmced materials	Filtration	Fine chemicals, (bio)pharmaceuticals	Carbon fiber	Solid-liquid mixing	Microparticle separation	CO_2 capture	Propylene-propane splitting	CO_2 to fuels	(Bio)chromatography	Zeolite synthesis	Water splitting
Microwave heating	1												
3D-Printing		2, 7, 10											
Structured materials			3								19		
Batch-to-continuous				4, 5, 6									
Plasma		11			8					18			
Flow reactors				9									
Electrospinning		11											
In-line mixer						12, 14							
Microfluidics							15						
MOF								16	17				
Oscillatory flow reactor												20	
Photocatalytic reactor													21

CLUSTER TAGS denote selected news about PI-technologies that are relevant for one or more topic clusters related to global industrial challenges and megatrends: SUSTAINABILITY, DIGITALIZATION, NEW (ADVANCED) MATERIALS and MODULARIZATION

CLUSTER TAG: SUSTAINABILITY

1. Microwave-Assisted Pyrolysis Process to Convert Agri Waste, Plastic to Biofuel

Researchers at the Indian Institute of Technology Madras have developed a microwave process to produce biofuel from plastic waste, rice straw and sugarcane bagasse. A team of three researchers led by R. Vinu, associate professor in Chemical engineering department, published its research work in peer-reviewed journal 'Bioresource Technology and Fuel Processing Technology'.

Biomass, as a renewable source of carbon with immense potential, leaves no carbon footprint. To make bio-oils competitive with fossil fuels, their oxygenate content must be reduced and hydrogen content increased. When plastics, rich in hydrogen, are added to biomass they enable conversion to low-oxygenate bio-oils. Plastics also help to produce bio-oils with better properties besides tackling the waste. Bio-oils not only yield high energy and fuel but also reduce char formation.

The team microwaved a variety of biomass including rice straw, sugarcane bagasse, groundnut shells, wood sawdust and wood with two synthetic plastics, polypropylene and polystyrene.

https://www.thehindu.com/news/national/tamil-nadu/iit-madras-researchers-use-agri-waste-plastic-to-make-biofuel/article31833372.ece

---

CLUSTER TAG: NEW (ADVANCED) MATERIALS

2. DSM Acquires Part of Clariant's 3D Printing Business

Royal DSM and Clariant have recently announced an agreement for DSM to take over certain parts of Clariant's 3D printing business portfolio. The agreement allows DSM to offer customers rapid product development iterations for filaments and pellets based on application needs. The combination of DSM's filament and pellet capabilities and former Clariant 3D printing activities will be able to better serve those needs, bringing customers quick tweaking of high performance filaments and pellets based on market needs.
The upcoming integration of these assets enables DSM to strengthen its engineering grade filament, pellet and powder portfolio. The transaction includes a part of the Clariant 3D printing team, selection of their portfolio and pipeline of engineering-grade filament and pellet materials and customer relations, expertise in powder development, and a small production line for fast ramp-up of small batches.

https://www.process-worldwide.com/dsm-acquires-part-of-clariants-3d-printing-business-a-942808/?cmp=nl-206&uuid=E1FF1370-FF89-461E-AF7670AA2676CB3D

CLUSTER TAG: NEW (ADVANCED) MATERIALS

3. The 3-D Filter Structure Makes the Difference

With its specially aligned three-dimensional fiber matrix, the AS Depth filter cartridge with 3D filter structure from Wolftechnik has up to 5 times more dirt holding capacity than conventional depth filter cartridges for classification. The 3-D filter structure is particularly suitable for the classification of slurries with high solid content.

The AS Depth filter cartridge is a high volume classification cartridge with a constant pore structure. The special 3D Depth filter construction consists of rolled filter layers made of PP-Bi-component-fibres which are separated from each other by a drainage mesh. The resulting, very voluminous filter structure enables extra high dirt hold capacity, states the firm. The filter layers of PP-Bi-component-fibres guarantee high throughput capacity without loss of particle retention rate even at high differential pressures. The filter cartridges with 3D depth filter structure ensure reproducible filtration properties for high-quality applications, adds the company.

Applications include the manufacture of silicon wafers for solar cells and computer chips, the manufacture of polishing pastes for the optical industry, the manufacture of varnishes, paints, inks, acids and lyes, fine chemicals, solvents, food and beverage, cosmetics and ultrapure water. In addition to the classification of slurry as the basic material for the production of Lib electrodes, they are also particularly suitable for classifying other liquids with high solids content in the production of technical ceramics for the electronics industry for producing light elements.

https://www.process-worldwide.com/the-3-d-filter-structure-makes-the-difference-a-946345/?cmp=nl-206&uuid=E1FF1370-FF89-461E-AF7670AA2676CB3D

CLUSTER TAGS: SUSTAINABILITY, MODULARIZATION

4. Pharmaceutical Continuous Manufacturing Technology

In order to bring continuous processing technology to a broader pharmaceutical customer segment, Gea Group AG has repositioned its Consigma portfolio to ensure that new drugs can be brought to market as quickly and cost-effectively as possible. The firm has taken a major step to make its cutting-edge continuous manufacturing equipment available to all. By taking a more holistic and inclusive stance as a trusted supplier to the pharmaceutical industry, the firm can now deliver an unparalleled

combination of highly effective, flexible, modularised and cost-efficient production solutions to a wider and more diverse array of companies.

Committed to ‘engineering for a better world,’ the company has expanded, integrated and consolidated its Consigma portfolio of continuous oral solid dosage equipment. From material handling, dispensing and blending to granulation, drying, tablet compression and coating, the firm can now provide top-of-the-range, fully configurable manufacturing systems that convert powder to coated tablets in a single line, as well as customer-specific ‘bin-to-bin’ solutions and connect them to the existing plant, opines the company.

https://www.process-worldwide.com/continuous-manufacturing-technology-is-now-available-to-all-a-946751/?cmp=nl-206&uuid=E1FF1370-FF89-461E-AF7670AA2676CB3D

CLUSTER TAGS: SUSTAINABILITY; MODULARIZATION

5. Continuous Manufacturing of Formulations in Minutes instead of Hours

Microinnova Engineering GmbH has successfully commissioned two continuous formulation production plants to a European client. The design of the fully automated plant is very compact, which makes it possible to easily transport it to the other side of the world to be used at a different manufacturing site. It possesses an integrated Plug & Play concept, which means that the 14-tons-per-day production plant can be connected at a new production site in a very short time. This provides an easy capacity increase for the client and their product.

This plant replaces several batch vessels, reduces processing time from hours to minutes, minimizes work hours and waste, enables constant product quality, increases safety and can be upgraded for different products. The continuous mixing system is fully automated and can easily be connected to the local site IT systems, such as SAP.

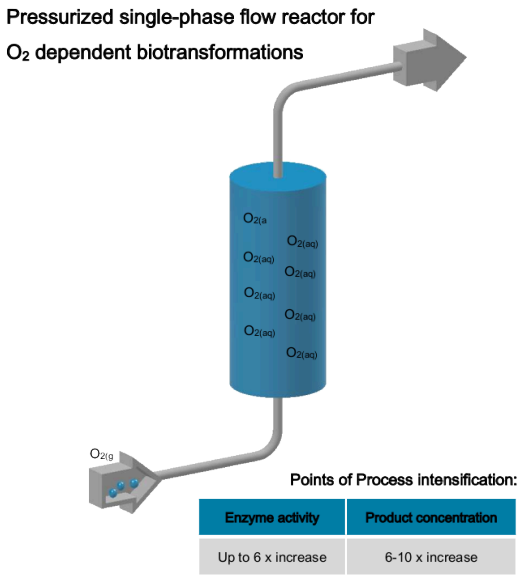
http://www.microinnova.com/index.php/en/about-us/news

CLUSTER TAG: SUSTAINABILITY

6. Performance Boost for Enzymatic Oxidations by means of Process Intensification and Continuous Flow Processing

Process intensification for oxidative O_2-dependent biotransformations is a promising tool using a batch-to-conti approach. In a cooperation between the Austrian Center of Industrial Biotechnology (ACIB) and Microinnova Engineering GmbH it was shown that process intensification applying continuous flow technology offers a comprehensive solution.

A continuous flow reactor using up to 34 bars enables biotransformations to be conducted in a single liquid phase. Increased enzyme activity has been detected already at 10 bars. For glucose oxidase the intensification factor for enzyme activity was up to 2.5, and amino acid oxidase showed an intensification factor up to 6 for the enzyme activity. High product concentration, with the concentration being 6 to 10 times higher at 34 bars compared to atmospheric pressure has been demonstrated. Reactions of glucose oxidase and amino acid oxidase were used both as soluble enzyme in liquid flow and immobilized enzyme in a packed bed as exemplary cases to demonstrate that the pressurized continuous flow reactor presents a powerful engineering tool uniquely apt to overcome restrictions inherent to the individual O_2-dependent transformation considered. The base for the performance push when using up to 34 bars of pressure is a 34 – 170 fold increase of dissolved oxygen compared to oxygen dissolved at atmospheric pressure.



http://www.microinnova.com/index.php/en/about-us/news

CLUSTER TAG: NEW (ADVANCED) MATERIALS

7. High-Resolution 3D-Printing Makes Small, Structured Parts

Manufacturing of centimeter-sized test specimens for material characterization according to ISO standards has now been achieved for the first time with a technology that allows 3D-printing a feature size of 200 nm. UpNano GmbH (Vienna, Austria; www.upnano.at) succeeded in printing test specimens from its specific photopolymer with its NanoOne-printer in sizes and shapes necessary for ISO tests. This achievement is the result of a productive collaboration with the Vienna University of Technology (www.tuwien.at).

Previously, it was considered impossible to print specimens at the (large) size necessary for ISO tests with a photopolymer and a two-photon-polymerization (2PP) 3D-printer that at the same time is able to achieve a resolution in the sub-micrometer range, says the company. The laser lithography system is capable of producing polymeric micro-scale parts and meso-scale components with micro-scale features and nanometer resolution. The system is based on 2PP, which is the key to the high resolution. Compared to laser systems that are based on one-photon absorption, two-photon absorption has a much higher spatial selectivity, because the probability of absorbing two photons is significantly reduced outside the focal point. This enables the system to print structures with dimensions from nano- to centimeter scale. Also, the company says it can print such structures 100 times faster than standard techniques.

The technology can be used for the production of micro-sized parts with a grid or other complex structures (photo); large porous structures; and even for printing living cells for in vitro cell testing, as well as scaffolds for living cells and sterile microfluidic elements.

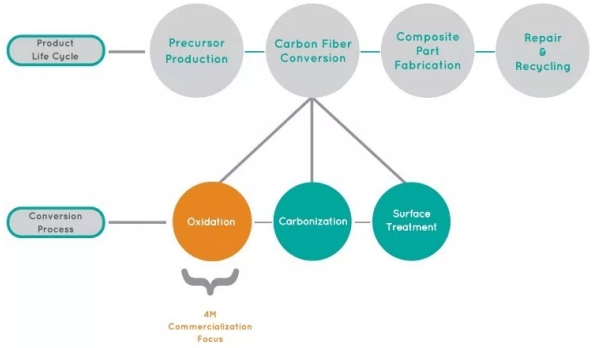
Chemical Engineering, 1 July 2020.

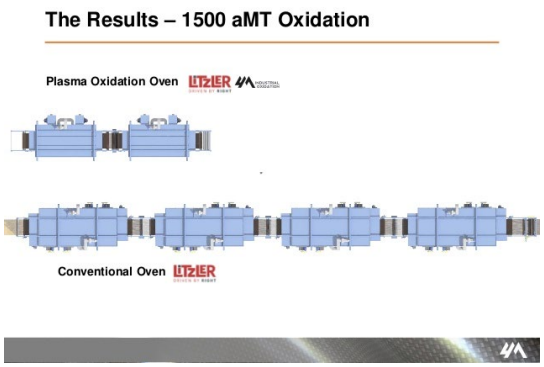
CLUSTER TAGS: NEW (ADVANCED) MATERIALS, SUSTAINABILITY

8. 4M Carbon Fiber Corp. Gains Patent Rights for Plasma Oxidation of Polymeric Materials in Republic of Korea

4M Carbon Fiber Corp. (4M) announced that a new patent for the Company's plasma oxidation technology was issued by the South Korean Patent Office on April 8, 2020. The patent covers 4M's use of the plasma oxidation process in that country. This further strengthens the protection and exclusivity 4M has on its technology around the world. 4M already has five issued patents in the United States and multiple other patents issued worldwide.

Interest continues to grow from the carbon fiber industry as 4M prepares to utilize its proprietary plasma oxidation technology to meet the growing worldwide demand for carbon fiber. Compared to conventional oxidation, plasma oxidation is three times faster and uses less than one third the energy, leading to reduced manufacturing costs and increased throughput.





http://4mio.com/4m-carbon-fiber-corp-gains-new-republic-of-korea-patent-rights-for-plasma-oxidation-of-polymeric-materials/

---

9. Coflore RTR – New Production-Scale Reactor from AM Technology.

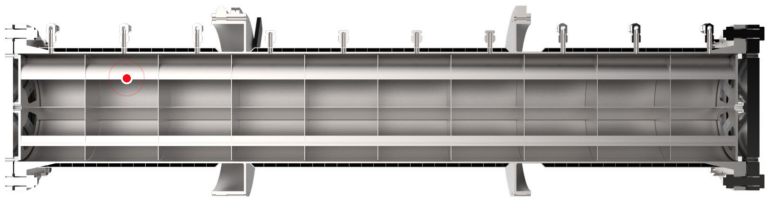
AM Technology has many years experience in designing and building flow reactors. The latest development, the Coflore® RTR, opens the door to all of the desirable benefits of flow, whilst incorporating vast improvements in throughput, scalability and versatility normally only associated with batch chemical processing.

The Coflore RTR has a 100 L capacity that is capable of processing countless reactor volumes without interruption. For a 5-minute residence time, the RTR can produce 1,200 L continuously per hour, or 28,800 L continuously per day. Such high-throughputs have the potential to produce many thousands of tonnes of material per year. An easy route from laboratory to production and a high level of versatility have also been established, whilst offering the very desirable advantages of flow technology.

The Coflore RTR operates as a ten-stage, actively-mixed, self-baffling continuous flow reactor with very efficient plug-flow characteristics. According to the CSTRs in

series model, the RTR flow reactor behaves as ten theoretical stages. The Coflore RTR employs inertia-generated radial mixing that gives high performance mixing without the need for rotating drive shafts, mechanical seals or wall-mounted baffles. Such advancements overcome difficulties in mixing that can be present in flow designs when processing higher volumes and throughputs. This leads to a simple but effective design that overcomes blocking and fouling, issues that have traditionally associated with continuous reactors.

The axial blades rotate in reciprocating cycles to give self-baffling and radial mixing. Maximum turbulence and shear conditions exist at the very outer region of the tube to optimise multi-phase handling characteristics. This delivers short mixing times, excellent mass-transfer conditions and optimum heat-transfer, whilst eliminating back-mixing to maintain orderly flow, with mixing independent of residence time.



Size comparison: Coflore RTR vs 7000 L batch reactor. For a 20 min residence time, the Coflore RTR can process >7000 L in less than 24 h

https://www.amt.uk/production-plant

CLUSTER TAG: NEW (ADVANCED) MATERIALS

10. Evonik Opens New 3D Printing Technology Center

Evonik is further expanding its business in the area of additive manufacturing. The specialty chemicals company has opened a new technology center for 3D printing in Austin, Texas. The U.S. site will play a key role within Evonik's global innovation network in the development of new, ready-to-use materials for powder bed fusion manufactured by the Structured Polymers technology.

Pioneer in powder materials for powder bed fusion Evonik's new Center for Structured Polymers Technology comprises an application technology laboratory with 3D printers and a processing area, a research and development laboratory, production rooms and associated office areas as well as meeting rooms. The building complex has modern air extraction systems, meets the highest safety standards and complies with applicable workplace ergonomics standards.

https://www.process-worldwide.com/evonik-opens-new-3d-printing-technology-center-a-949498/?cmp=nl-206&uuid=E1FF1370-FF89-461E-AF7670AA2676CB3D

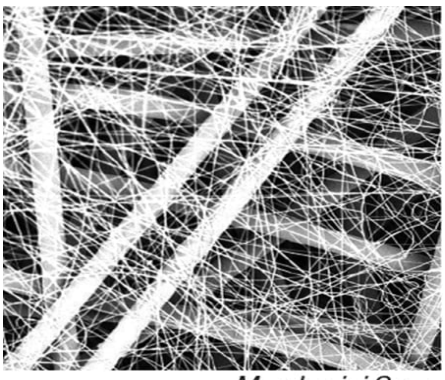
CLUSTER TAG: NEW (ADVANCED) MATERIALS

11. Making New Masks by Combination of Elctrospinning and Corona Discharge

The Marchesini Group S.p.A. (Pianoro Bologna, Italy; www.marchesini.com) and a multidisciplinary research group at Bologna University (www.unibo.it) have created a prototype that manufactures “super” filtering material for face masks with greater protection against viruses and bacteria compared to materials currently in use. Moreover, the filter media (photo) has an excellent particle-filtration capacity, and can be applied to fabrics not normally used to produce face masks.

“The prototype enables industrial-scale production of this new type of filtration material, based on electrocharged polymer nanofibers,” explains Andrea Zucchelli, a professor with the Dept. of Industrial Engineering (DIN) at Bologna University, and one of the project coordinators. “Only a University environment could nurture and support a project of this kind, designed to rapidly and effectively combine notions from the fields of mechanical engineering, polymer research and electrical engineering to develop an advanced electrospinning technology,” Zucchelli says. “Thanks to this synergy, we succeeded in combining electrospinning technology, which allows us to produce material with nanometric fibers, with corona discharge, thanks to which we were able to obtain nanofibers with a high electrostatic charge”.

Once up and running, the prototype, which is housed in the laboratory of the DIN in Bologna, will produce enough filtration material for around seven thousand masks per day. The first production runs of these materials will be used to produce a prototype batch of FFP3-type masks by GVS S.p.A. (Zola Predosa, Italy).



Marchesini Group

Chemical Engineering, 1 August 2020

---

12. Two-Stage Solid-Liquid Mixing in Batch Operations

Ika's CMX 2000 is an inline mixer for fast, homogeneous incorporation of powders into liquids. The circulation of the liquid creates a strong vacuum in the machine, which sucks in the solid material. Thus, even powders that are difficult to wet can be incorporated lump-free into a liquid phase.

The two-stage design with a pumping and dispersing stage ensures stable functionality even at high viscosities. Due to the highly efficient mode of operation of the CMX, production time and raw material usage can be saved, states the company. The optimum dispersion quality can be achieved with specific tools. The inline mixer is usually supplied as a system with solids dosing and a mixing vessel. Depending on the application and customer requirements, the solids feed can be designed as a big bag system, via a hopper, by means of a sack chute or a suction lance directly sucking from the sack.

Different installation and process requirements are not a problem: the inline mixer can be installed horizontally or vertically and has a low installation height. The closed system prevents dust and solvent emissions, concludes the firm.

https://www.process-worldwide.com/two-stage-solid-liquid-mixing-in-batch-operations-a-953085/?cmp=nl-206&uuid=E1FF1370-FF89-461E-AF7670AA2676CB3D

CLUSTER TAG: SUSTAINABILITY

13. First Large-Scale Chemical Facility to Be Fully Powered by Renewable Energy

A chemical plant run by Sabic in Caragena is to become the world`s first of its kind to operate on 100 % renewable power. A deal signed in this respect, will see Iberdrola, one of the world’s biggest electricity utility companies, invest almost $ 83 million to construct a 100 MW solar PV facility with 263,000 panels, on land owned by the chemical company, making it the largest industrial renewable power plant in Europe. The plant is expected to be fully operational in 2024.

The 25-year deal represents another step in the company's plans to transition all its global operations to cleaner energy. The group's aim is to have 4 GW of either wind or solar energy installed for its sites globally by 2025, rising to 12 GW by 2030. In 2019, solar panels were installed at sites in India and Thailand, helping reduce greenhouse emissions by 200 tons. Plans are also underway to install PV technology at the company's global HQ in Riyadh, and a final-stage feasibility study with Marafiq and the Royal Commission for Jubail and Yanbu is underway to explore a $ 300 million, 300-MW solar array project on the western coast of Saudi Arabia. Once complete, Sabic plans to take the electricity generated by the plant and deliver it to local chemicals manufacturing plants.

https://www.process-worldwide.com/first-large-scale-chemical-facility-to-be-fully-powered-by-renewable-energy-a-952911/?cmp=nl-206&uuid=E1FF1370-FF89-461E-AF7670AA2676CB3D

---

14. The Turbo Compact Mixer

Gericke's unique experience in continuous mixing and feeding has resulted in a new family of mixing solutions. With the TCM Turbo Compact Mixer it is possible to continuously and fully automatically feed and mix up to four streams with minimum space requirements and high accuracy. This makes the compact mixer ideally suited for products that guarantee zero cross-contamination handling of allergens.

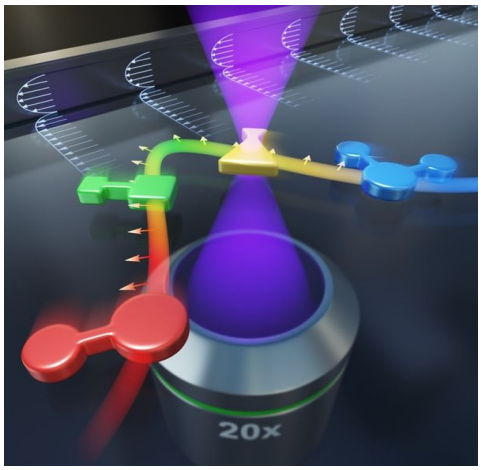
The complete disassembly allows easy and quick cleaning. Even the mixing chamber is removable. Downtime due to cleaning is reduced by up to 90 %, states the company. With the small volumes, recipe accuracy is guaranteed even with frequent start-stop operation, which has been confirmed in an extensive series of tests. Despite the compact size, capacities of up to 20'000 l/h can be realized, adds the firm. The mixing process is both fast and gentle, and prevents segregation when used directly before filling or extrusion lines.

https://www.process-worldwide.com/the-turbo-compact-mixer-one-step-ahead-a-953368/?cmp=nl-206&uuid=E1FF1370-FF89-461E-AF7670AA2676CB3D

CLUSTER TAG: NEW (ADVANCED) MATERIALS

15. TU Delft researchers separate microparticles on the basis of their shape

Scientists in Delft have developed a technique for selectively separating microparticles in a liquid on the basis of their shape. The technique calculates precisely the path that a specifically shaped microparticle will follow in a flow through a narrow tube. This makes it possible to set up a sorting channel, in which the differently shaped particles each find their own way. The new technique can be used in a range of sectors, for example in the manufacture of medicines or removing microplastics from water.



There are countless examples of microparticles suspended in liquids, such as the red blood cells in our blood, bacteria in drinking water and microplastics in the wastewater from the washing machine. If we want to filter these particles out of the liquid, we can do this on the basis of their size using a sieve. However, in some processes it is essential to separate particles that are the same size but have a different shape. Up to now, this has only been possible using an external source such as a light, magnetic or electric field. This requires cumbersome equipment, and the microparticles cannot always be separated using these external sources. One example is the manufacture of medicines. The technique developed by researchers Rumen Georgiev and H. Burak Eral works solely on the basis of the forces exerted on the particles in the flow through a narrow tube, no wider than a human hair. A formula can be used to calculate which path a microparticle with a certain shape will take. This even makes it possible to sort differently shaped particles in a liquid simultaneously by arranging the narrow tube as a motorway with different exits.

This technique can be used in many fields, from medicine to wastewater treatment. Eral sees particular potential for developing minuscule labs on a chip and in separation technologies for industrial purposes. The principle can also be used in larger scale production processes in the pharmaceuticals industry.

TU Delft News, 25 August 2020

CLUSTER TAG: NEW (ADVANCED) MATERIALS

16. A Steam-Stable MOF for High-Capacity Carbon Capture

A recently discovered family of highly porous metal-organic framework (MOF) materials is showing promise in carbon-capture applications. Researchers from University of California, Berkeley (www.berkeley.edu), Lawrence Berkeley National Laboratory (LBL; www.lbl.gov) and ExxonMobil Corp. (Irving, Tex.; www.exxonmobil.com) demonstrated the efficacy of the new tetra-amine-functionalized magnesium-based MOFs in removing CO_2 emissions — reporting a six-fold increase in effectiveness over conventional amine-based carbon-capture methods.

“This family of MOF materials has a very high density of metals in the three-dimensional porous framework, and these metals have open coordination sites. This high density means we can incorporate a large number of amine groups bound to these open metal sites in an ordered fashion, which in turn leads to the potential for a high capture capacity for CO_2,” explains Simon Weston, senior research associate and the project lead at ExxonMobil Research and Engineering Co. He adds that while earlier research looked at incorporating diamine groups into the MOF, which only provided one attachment point for CO_2, switching to tetra-amines provided additional attachment points and also served to improve the material’s thermal stability during steam cycling. This stability enables regeneration (and therefore, repeated re-use) of the material using steam at relatively low temperatures (110–120°C), which decreases overall energy consumption when compared to other carbon-capture methods.

The team’s work has demonstrated that the MOFs are highly selective for CO_2 and could capture over 90% of the CO_2 emitted from industrial sources. The combination of this high CO_2-capture capacity alongside thermal stability and ease of regeneration using low-temperature steam make this material an attractive prospect for industrial carbon capture.

The Chemical Engineer, 1 September 2020.

CLUSTER TAG: NEW (ADVANCED) MATERIALS

17. ‘Porous Liquids’

A new material that promises to save up to 80% of the energy used to separate propylene from propane (by distillation) has been developed by a team of researchers from the Karlsruhe Institute of Technology (KIT; Germany; www.kit.edu), Leibniz Universität Hannover, KAUST and the German Institute of Rubber Technology e.V. (Hannover).

As described in a recent issue of Nature Materials, the researchers have been able to distribute a metal-organic framework (MOF) in a liquid for the first time. To do this, they started with the solid material ZIF-67 (zeolitic imidazole framework), whose atoms form a MOF with 0.34-nm wide pore openings. By systematically modifying the surface of ZIF-67 nanoparticles, it becomes possible to form a dispersion of the MOF in liquids, such as cyclohexane, cyclooctane or mesitylene. Because propylene is retained in the pores of this so-called porous liquid, it can effectively be separated from smaller molecules that pass through more quickly.

The researchers also produced mixed-matrix membranes from a plastic material containing up to 47.5% of the chemically modified ZIF-67. Two such membranes arranged in series were able to produce propylene with 99.9% purity from a gas mixture containing equal parts of propylene and propane — even though the molecules differ in size by just 0.2 nm.

The flowrate was at least three times higher than alternative membranes, which makes the new membranes even more promising as an alternative to conventional distillation separation.

Chemical Engineering, 1 September 2020

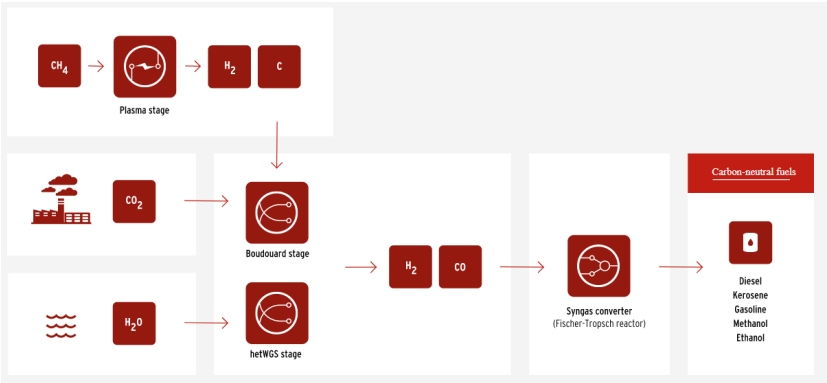
CLUSTER TAG: SUSTAINABILITY

18. Plasma Process Converts CO_2 into synthetic fuels

German company CAPHENIA GmbH has developed an innovative technology for producing synthesis gas from biogas, carbon dioxide, water, and electricity. What is special about the CAPHENIA process is that everything takes place in a single 'zone reactor', in which chemical reactions can be controlled in a highly targeted way. In conventional processes, many reactors would be required for the process of turning CO_2 into the synthesis gas. Production in the CAPHENIA zone reactor is simpler, faster, and cheaper.

The key technology of the CAPHENIA process is the plasma process. First of all, methane is cracked in a plasma zone. This is done using a high-temperature plasma, which, at around 2,000°C, breaks down the methane into an aerosol of carbon and hydrogen. This aerosol is then mixed with preheated carbon dioxide.

In what's known as the Boudouard zone, carbon dioxide, together with hot carbon, is then converted to carbon monoxide. This conversion process is based on the well-established Boudouard reaction, which takes place at temperatures of around 1,000°C. This step exploits the high thermal energy of the gas from the plasma zone and converts it to chemical energy. Further, in what's known as the heterogeneous water-gas shift zone, water is also introduced in addition to CO_2. This water likewise reacts to form carbon monoxide and hydrogen.



https://caphenia.com/en/technology

---

19. A Fiber Matrix for Scalable Chromatography

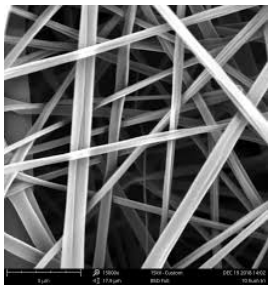
Cytiva (https://www.cytivalifesciences.com) has developed Fibro: a new technology for chromatography. Its fiber matrix allows for high binding capacities at very short residence times, resulting in increased throughput and productivity in mAb purification.

Biomanufacturing is trending towards higher numbers of monoclonal antibody (mAb) projects and smaller batch sizes. These trends are fueling demands to screen more clones faster, and improve the efficiency of process development and flexible multiproduct facilities in mAb manufacturing. To help meet these needs, Cytiva developed ready-to-use Fibro PrismA units for capturing mAbs. They are designed to

support researchers and process developers by enabling them to purify monoclonal antibodies with significantly improved throughput.

Fibro PrismA, is a scalable rapid cycling chromatography technology that complements chromatography resins, especially in circumstances where speed and flexibility are important. For large-scale manufacturing it increases flexibility and productivity through its single-use operations. This creates substantial cost savings, especially for multiproduct facilities, and helps bring therapies to market faster.

Fibro PrismA units have a protein A cellulose fiber matrix with an open pore structure. In this matrix, mass transfer is governed by convective flow. This structure allows high mAb binding capacities at very short residence times, which results in cycle times of minutes instead of the hours needed for resin-based chromatography.



In research and process development, the fast purification time results in up to 20 times increased throughput compared to resins. In clinical and commercial settings, the rapid cycling enables manufacturers to utilize the full lifetime of the unit (around 200 cycles) in a single batch-increasing productivity up to 400 g/L/h.

https://www.c2w.nl/partnercontent/a-fiber-matrix-for-scalable-chromatography

---

20. Arkema Flow Success with NiTech

Arkema, the leading French specialty materials company, has for the first time, achieved the continuous flow synthesis of zeolite NaX using a NiTech© continuous oscillatory baffled reactor (COBR). The validation of the system in a pilot-scale (so far up to 50 litres/hour) provides the potential for reliable scaling up to industrial-sized production.

The success highlights some key benefits of NiTech's technology:

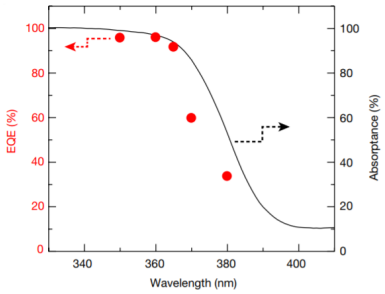
- The use of a COBR not only allowed the same residence time as the batch system, but also a controlled temperature profile, thanks to the plug flow behavior and effective heat transfer;
- The consistent mixing environment provided by the COBR was suitable for the handling of zeolite crystals avoiding sedimentation and preventing blockage;
- The plug flow behavior, characteristic of COBRs, allowed matching the residence time necessary to complete crystallization of the batch system;
- After 5 hours of operation, reactor walls were incrustation-free;
- The enhanced heat transfer provided by the COBR resulted in a controlled temperature profile along the reactor during the operation.

NiTech Solutions Newsletter, July 2020.

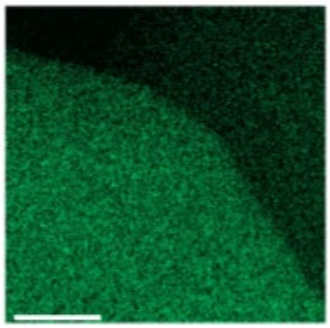
CLUSTER TAGS: SUSTAINABILITY, NEW (ADVANCED) MATERIALS

21. Splitting water with UV is now at almost 100% quantum efficiency

Water splitting through photocatalysis has been a promising method of achieving solar hydrogen production for decades. However, most previous attempts only yielded an external quantum efficiency of less than about 50% representing the difficulty in efficient catalyst design for real world use. The catalyst needed to be designed better so every absorbed photon from the light source is used to make hydrogen. The key to improving efficiency was strategic placement of the co-catalysts and preventing defects in the semiconductor.



Published in Nature, Tsuyoshi Takata of Shinshu University et al. broke through new frontiers in power production by using aluminum-doped strontium titanate as a photocatalyst, whose properties have been extensively studied and therefore the best understood. They choose co-catalysts rhodium for hydrogen with chromium oxide, and cobalt-oxide for oxygen, by fine-tuning them to engage in only desired reactions. This method made possible for the reaction to have no recombination losses.



These new findings open the doors to achieve scalable and economically viable solar hydrogen production. Their design strategies succeeded in reducing defects that lead to near perfect efficiency, and knowledge obtained will be applied to other materials with intense visible light absorption.

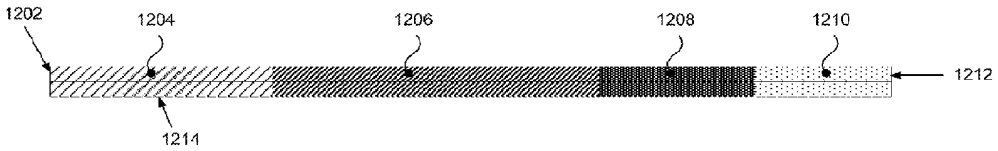
https://www.sciencedaily.com/releases/2020/06/200603104547.htm

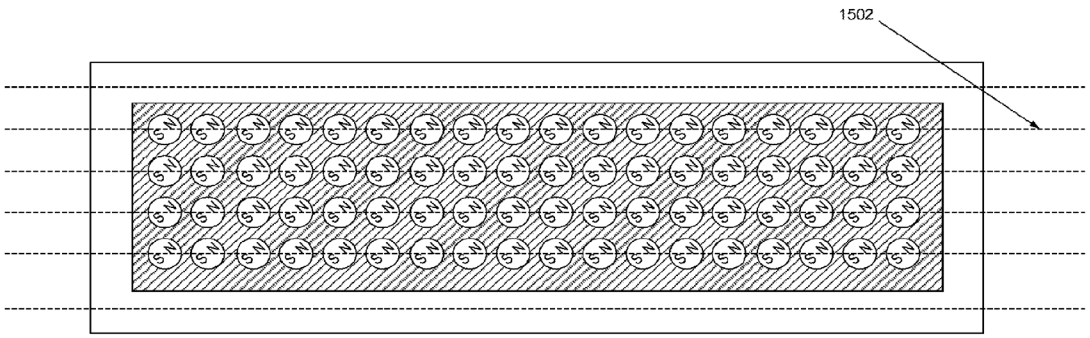
PATENT HIGHLIGHTS:

Inductively heated microchannel reactor

Publication number: AU2018375073 (A1)
Publication date: 2020-07-09
Inventor(s): O'CONNOR DAVID
Applicant(s): KONTAK LLC

The current document is directed to an efficient multi-channel chemical reactor having a multichannel core containing a plurality of parallel channels, with conductive walls, having a varying composition along their lengths. The channels are heated by a frequency-addressing different regions within the reactor with an inductive coil, driven by an agile frequency or spread spectrum emission controlle

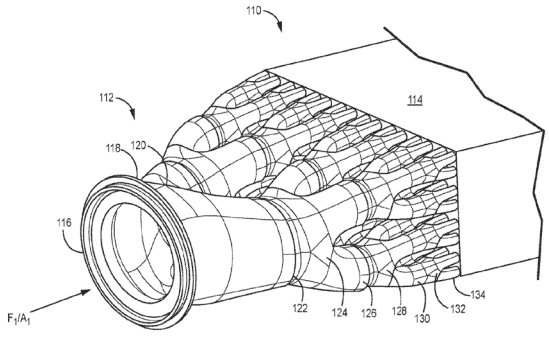




HEAT EXCHANGER HEADER WITH FRACTAL GEOMETRY

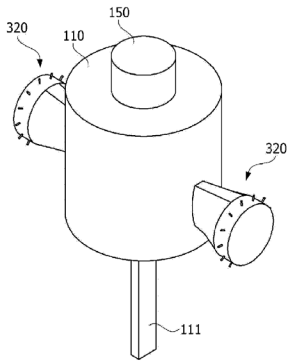
Publication number: US2020284532 (A1)
Publication date: 2020-09-10
Inventor(s): BECENE AHMET T [US]; RUIZ GABRIEL [US]; FENG FENG [US]; MAYNARD MICHAEL [US]; DOE MICHAEL [US]; HU MICHELE [US]; JOSEPH EPHRAIM [US]
Applicant(s): HAMILTON SUNDSTRAND CORP [US]

A heat exchanger header for receiving a first fluid includes a tubular primary fluid channel oriented along a first axis and having a first cross-sectional area. A first branched region adjacent to the primary fluid channel fluidly connects to a plurality of tubular secondary fluid channels, each having a second cross-sectional area, and a



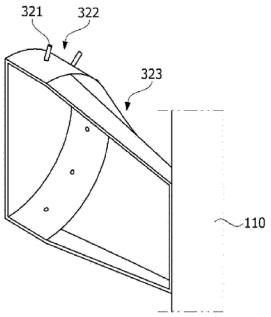
second branched region adjacent to each of the secondary fluid channels fluidly connects to a plurality of tubular tertiary fluid channels, each having a third cross-sectional area. The second cross-sectional area is greater than the third cross-sectional area.

NANOPARTICLE PRODUCTION REACTOR



Publication number: EP3680010 (A1)
Publication date: 2020-07-15
Inventor(s): KIM EUN JEONG [KR]; CHOI JUN WON [KR]; JUNG JIN MI [KR]; IM YE HOON [KR]; SHIN BU GON [KR]
Applicant(s): LG CHEMICAL LTD [KR]

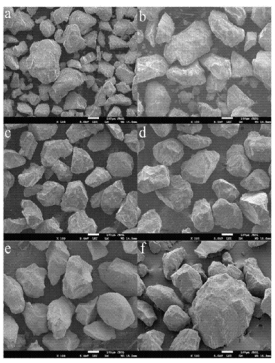
The present invention relates to a reactor for nanoparticle production, and according to one aspect of the present invention, there is provided a reactor for nanoparticle production, comprising a main chamber including a first nozzle to which raw material gas is supplied, a lens housing connected to the main chamber in a fluidly movable manner and including a second nozzle for supplying flushing gas therein, a lens mounted on the lens housing, a light source for irradiation of a laser for passing through the lens to reach the raw material gas in the main chamber, and a hood for discharging nanoparticles generated in the main chamber, wherein the lens housing is provided so that a cross-sectional area of at least a part of a region decreases along the direction facing the main chamber.



MICROWAVE-ASSISTED CATALYTIC REACTIONS USING MODIFIED BED PARTICLES

Publication number: US2020223692 (A1)
Publication date: 2020-07-16
Inventor(s): HAMZEHLOUIA SEPEHR [CA]; CHAOUKI JAMAL [CA]
Applicant(s): POLYVALOR LP [CA]

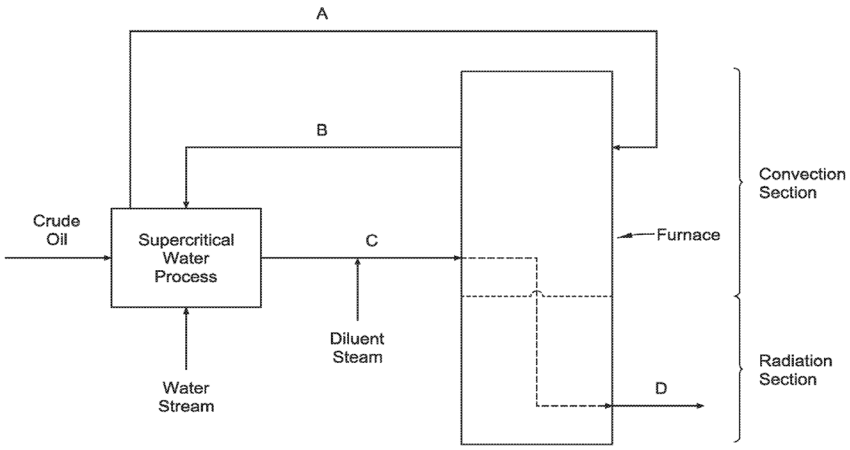
A modified bed particles, related methods and applications in processes involving microwave-assisted catalytic reactions. The bed particles modified to be used as a microwave receptor that is capable to simultaneously sustain heat generation mechanisms under microwave irradiations and physically act as catalyst support. The bed particle comprises a dielectric coating deposited on an external surface of a core, the bed particle being sized for use in a fixed bed reactor or a fluidized bed reactor. The bed particles may further comprise a catalytically active material supported on a surface of the dielectric coating. Irradiating the gas-solid reactor with microwaves enables heating the dielectric coating of the solid bed particles, the dielectric coating locally transferring thermal energy to the surrounding gaseous reactants which are thereby selectively converted into the primary products.



INTEGRATED SUPERCRITICAL WATER AND STEAM CRACKING PROCESS

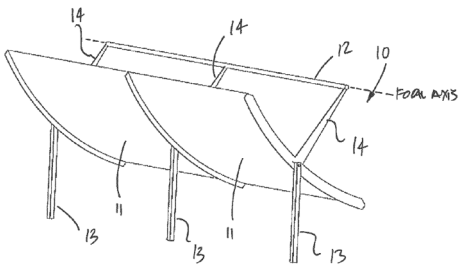
Publication number: US2020270535 (A1)
Publication date: 2020-08-27
Inventor(s): CHOI KI-HYOUK [SA]; ALABDULHADI ABDULLAH T [SA]; MARTINEZ GONZALO FEIJOO [SA]; ALSOMALI ALI M [SA]; ALABDULLAH MOHAMMAD A [SA]; AL-SAYED ESSAM A [SA]
Applicant(s): SAUDI ARABIAN OIL CO [SA]

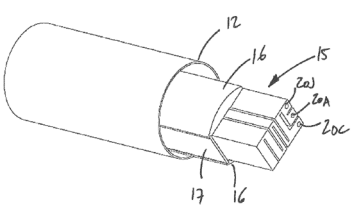
A method for producing a supercritical water (SCW)-treated product is provided. The method comprising the steps of introducing a crude oil stream and a water stream to a supercritical water process, wherein the crude oil stream can undergo conversion reactions to produce the supercritical water (SCW)-treated product, wherein the SCW-treated product includes an increased paraffin concentration as compared to crude oil stream. The method further includes the step of introducing the SCW-treated product to a steam cracking process, wherein the SCW-treated product can undergo conversion reactions to produce furnace effluent.



INTEGRATED SOLAR MICRO-REACTORS FOR HYDROGEN SYNTHESIS VIA STEAM METHANE REFORMING

Publication number: EP3710399 (A1)
Publication date: 2020-09-23
Inventor(s): DUFAULT JEAN-FRANÇOIS [CA]; PICARD MATHIEU [CA]; FRECHETTE LUC [CA]; BRAIDY NADI [CA]
Applicant(s): SOCIETÉ DE COMMERCIALISATION DES PRODUITS DE LA RECH APPLIQUÉE SOCPRA SCIENCES ET GÉNIE SEC [CA]





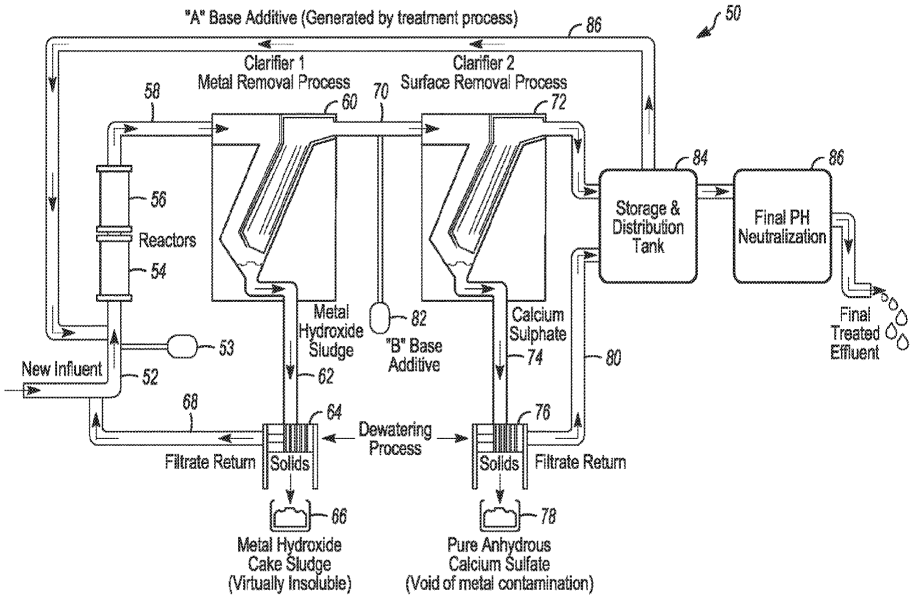
A reactor for steam-methane reforming is adapted to be received in a tube on a focal axis of a parabolic trough. The reactor may comprise an array of micro-reactors interconnected by a water manifold, a gas manifold, a syngas manifold, and at least one steam-methane reforming chamber configured for reforming steam and methane into syngases, the micro-reactors having a vaporization portion for

producing steam. Radiation plates may extend on sides of the array of micro-reactors. Glazing may face and be spaced apart from a portion of the array of micro-reactors including at least one steam-methane reforming chamber, the glazing being conductively connected to the radiation plates for heat transfer therebetween, the at least one glazing allowing light from the parabolic trough to pass therethrough to reach the array of micro-reactors.

COMPOSITION AND METHOD FOR TREATING AND REMEDIATING AQUEOUS WASTE STREAMS

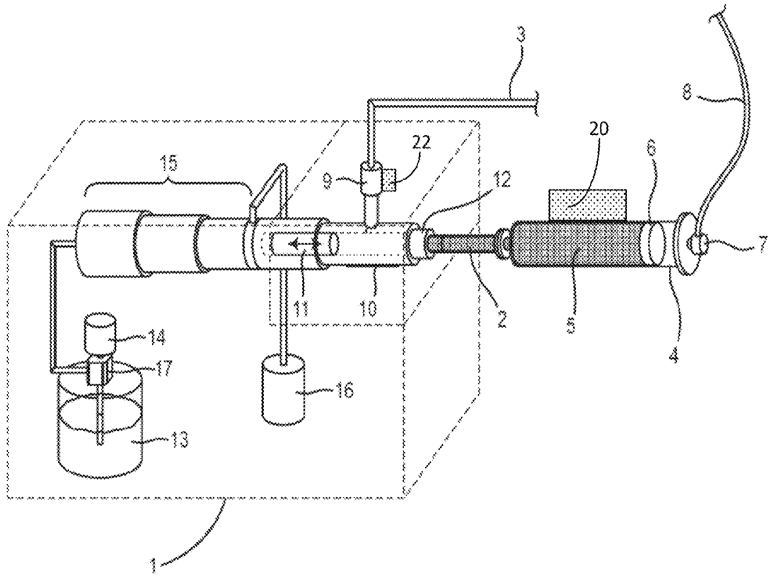
Publication number: US2020261921 (A1)
Publication date: 2020-08-20
Inventor(s): CARLSON LAWRENCE [US]
Applicant(s): TYGRUS LLC [US]

An apparatus for treating a stream of contaminated water having an elevated concentration of at least one of light metals, heavy metals, sulfates that includes at least one process fluid inlet communicating with a process conduit; at least one electrode reaction vessel in fluid communication with the process conduit, the reaction vessel having an interior chamber and at least one electrode positioned in the reaction chamber, the electrode powered by a alternating current source; and at least one magnetic field reaction vessel in fluid communication with the process conduit, the magnetic field reaction vessel having an outwardly oriented surface and an opposed inwardly oriented surface, the magnetic field reaction vessel having at least one magnet in contact with the inwardly oriented surface of the magnetic field reaction vessel.



SYSTEMS AND METHODS FOR PRODUCING MATERIALS SUITABLE FOR ADDITIVE MANUFACTURING USING A HYDRODYNAMIC CAVITATION APPARATUS

Publication number: US2020215724 (A1)
Publication date: 2020-07-09
Inventor(s): CAPOBIANCO JOSEPH ALBERT [US]; HANKEY DANA LYNN [US]; TIBBETTS MARSHALL CAMPION [US]
Applicant(s): APPLIED CAVITATION INC [US]
Provided in one implementation is a method that includes introducing a volume of raw material into a chamber of a cavitation machine. The raw material can include a mixture comprising a powder and a solvent. The powder can have a first average particle size in the raw material. The method includes applying a hydrodynamic cavitation process to the raw material to produce a product material. The powder can have a second average particle size, smaller than the first average particle size, in the product material. The method includes causing the product material to exit the cavitation chamber and drying the product material to remove the solvent. Apparatus employed to apply the method are also provided.

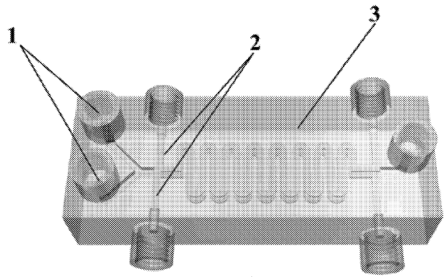


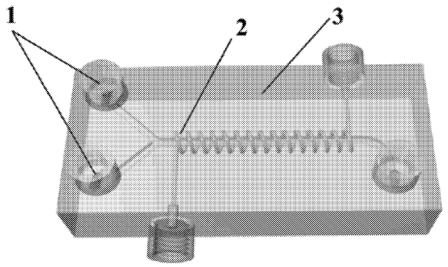
GENERAL-PURPOSE FLUORESCENT FLUIDIC PHOTOCHEMICAL MICROREACTOR AND MANUFACTURING METHOD THEREFOR BY 3D PRINTING

Publication number: WO2020177065 (A1)
Publication date: 2020-09-10
Inventor(s): ZHANG LIJING [CN]; TAO SHENGYANG [CN]; ZHU ZHIGANG [CN]; YANG WENBO [CN]
Applicant(s): UNIV DALIAN TECH [CN]

Disclosed are a general-purpose fluorescent fluidic photochemical microreactor and a manufacturing method therefor by means of 3D printing, belonging to the technical field of photochemical reactor research. By using a transparent photosensitive resin and the strong space building capacity of 3D printing, a photochemical microreactor having both a light-collecting channel and a reaction channel is prepared. By means of introducing a light-collecting substance in a fluid form into a light channel, not only can same play the role of light collection and wavelength conversion, which solves

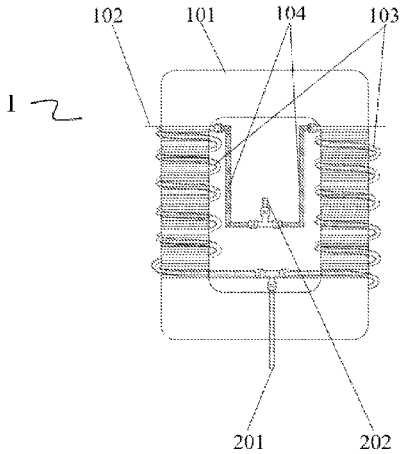
the difficulty of traditional photochemical reactors of light source matching, but the light-collecting substance can also be flexibly changed so as to meet the requirements of different photochemical reactions in the reaction channel, which greatly expands the application range of the reactor. The photochemical microreactor of the present invention is simple and fast to manufacture, can be produced on a large scale, and provides convenience for studying the rapid screening of reactions, the optimization of reaction conditions and reaction mechanisms, etc. A light-collecting material can be recycled, which reduces the material cost and does not pollute the environment.





CONTINUOUS INDUCTION HEATING REACTOR

Publication number: WO2020133099 (A1)
Publication date: 2020-07-02
Inventor(s): YANG NA [CN]; SUN HAN [CN]; JIN YAMEI [CN]; XU XUEMING [CN]
Applicant(s): INDUC SCIENT CO LTD [CN]

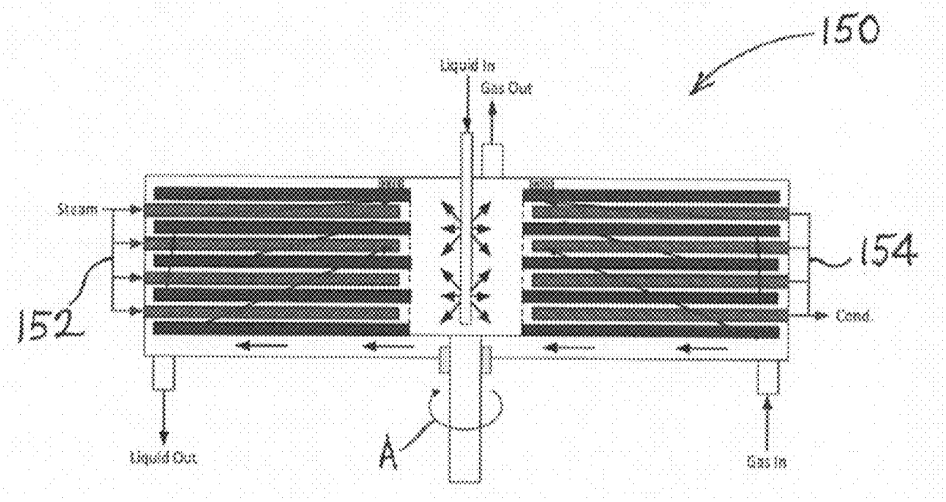


Disclosed is a continuous induction heating reactor, comprising a magnetic loop (101), a primary coil (102), a magnetic coupling tube (103) and a reaction cavity (104), wherein the magnetic loop (101) is made of a magnetically conductive material; the primary coil (102) and the magnetic coupling tube (103) are both wound around the magnetic loop (101), and the magnetic coupling tube (103) is connected to the reaction cavity (104); and a sample inlet (201) and a sample outlet (202) are arranged in the exact middle of the magnetic coupling tube (103) or the reaction cavity (104). The continuous inductive heating reactor heats a low-magnetic-conductivity sample with an electrical conductivity without any metal pole plate and electrode and without any external heat source or radiation, and is suitable for an open continuous flow treatment.

ROTATING PACKED BEDS WITH INTERNAL HEAT TRANSFER FOR ABSORPTION/REGENERATION APPLICATIONS

Publication number: US2020261846 (A1)
Publication date: 2020-08-20
Inventor(s): MOBLEY PAUL DAVID [US]; ZHOU SHAOJUN JAMES [US]
Applicant(s): RES TRIANGLE INST [US]

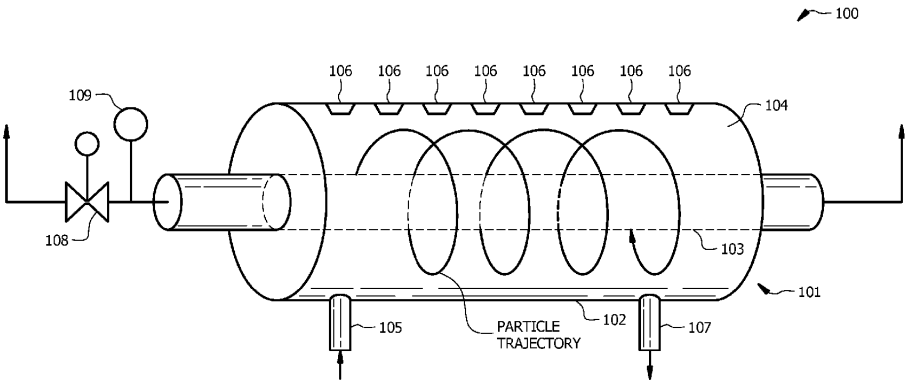
A gas-liquid contacting apparatus and method are described, in which at least one rotor assembly including packing is arranged in a contacting chamber containing at least one stator assembly including at least one heat exchanger arranged to thermally modulate the gas-liquid contacting so that each stator assembly is operatively arranged with each stator assembly to provide gas-liquid contacting at temperatures effective for mass exchange between the gas and liquid. The rotor and stator assemblies may be of annular shape, or may be of disk shape in a stacked array of rotor assemblies alternating with stator assemblies. Such apparatus and method are usefully employed for CO_2 capture from CO2-containing flue gases such as combustion effluents from power generation plants.



THREE-DIMENSIONAL ANNULAR ROTATING FLUIDIZED BED FLUID-SOLIDS CONTACTOR

Publication number: WO2020165832 (A1)
Publication date: 2020-08-20
Inventor(s): PANNALA SREEKANTH [US]; DITTRICH CHRISTOPH [NL]; WEST DAVID [US]; LI TINGWEN [US]
Applicant(s): SABIC GLOBAL TECH BV [NL]; PANNALA SREEKANTH [US]

A fluid-solids contactor comprising an annular rotating fluidized bed and a method of using the same are disclosed. The fluid-solids contactor includes a vessel and a plurality feed inlets disposed thereon. The vessel comprises a stationary inner wall, an outer wall, and a chamber formed between the stationary inner wall and the outer wall. The feed inlets are configured to create an annular rotating bed with mixture of solids and a fluid when the solid particles and a fluid are fed into the chamber. The stationary inner wall of the vessel is permeable to the fluid such that the fluid from the chamber can be continuously withdrawn from the solids to the space within the stationary inner wall of the vessel.



ABSORPTION-CONDENSATION METHOD OF DRYING NATURAL AND PROCESS GAS MIXTURES ON NANOPOROUS MEMBRANES

Publication number: RU2729243 (C1)
Publication date: 2020-08-05
Inventor(s): PETUKHOV DMITRIJ IGOREVICH [RU]; KOMKOVA MARIYA ANDREEVNA [RU]; BROTSMAN VIKTOR ANDREEVICH [RU]; POYARKOV ANDREJ ALEKSANDROVICH [RU]; ELISEEV ARTEM ANATOLEVICH [RU]; ELISEEV ANDREJ ANATOLEVICH [RU]
Applicant(s): FEDERALNOE GOSUDARSTVENNOE BYUDZHETNOE OBRAZOVATELNOE UCHREZHDENIE VYSSHEGO OBRAZOVANIYA "MOSKOVSKIJ [RU]

FIELD: membrane technologies. SUBSTANCE: invention relates to membrane technology and can be used for removal of water vapor and other condensed components from natural and process gas mixtures. Invention is a method of removing condensed components from gas mixtures by absorbing vapors with a cooled absorbent through a nanoporous membrane. Disclosed method of removing vapors using cooled absorbent allows reducing temperature of dew point of prepared gas to values by 10-15 °C lower than temperature of cooled absorbent, and drying to achieve performance of 12 n·m/(m(the membrane)·h), which corresponds to a specific volumetric productivity 40,000 n·m/(m(apparatus)·h). EFFECT: technical result achieved using the claimed invention is to provide a reduction in the maximum achievable dew point drying gas by reducing the equilibrium partial vapor pressure above the absorbent solution is cooled by more than 20 °C.10 cl, 6 dwg, 2 tbl