Explosives Go Green for the Environment

Since the late-19th century, lead azide and lead styphnate have been used worldwide as the primary explosives of choice despite the accumulation of toxic lead in human tissues and the environment.

Currently, the U.S. Army alone consumes more than 450 kg of lead-based primary explosives annually, equivalent to a release of more than 320 kg of lead to the environment.

Looking to curb these margins is My Hang Huynh at Los Alamos National Laboratory, N.M., developer of **Green Primaries: Enviro-Friendly Energetic Materials.** Green Primaries are novel explosive compounds that are environmentally friendly and nontoxic to human health, yet they also possess all the physical and chemical properties and sensitivities required of primary explosives. They are designed specifically to replace lead-based primaries in ammunition, detonators, and motor/actuator devices.

Green Primaries are made from nontoxic metals such as iron and copper, and, after detonation, leave behind no toxic residues. They also exhibit extraordinary sensitivities and properties, thereby improving worker safety during manufacturing and transport. Manufacturing of Green Primaries is water-based with no harmful organic solvents or heavy metals, and there is no danger of explosion during manufacture.

In addition, manufacturing is less expensive than lead-based primaries, as there are no added waste-disposal costs associated with this technology.

More info: www.lanl.gov

Dependable Drug Delivery

Although cardiologists may insert drug-eluting stents, none of the traditional stents today offer the benefit of slow, continuous drug elution over an extended period of time. To that end, scientists at Pacific Northwest National Laboratory, Richland, Wash., along with Micell Technologies, Raleigh, N.C., have developed **e-RESS: Revolutionizing Coatings with Nanoparticles.**

The e-RESS (Electro-static Rapid Expansion of Supercritical fluidS) process is a method to deposit nanoparticulate coatings in a few simple processing steps. It is expected to give cardio-implant patients the comfort of better drug delivery and longer implant integrity.

The e-RESS process controls the pharmaceutical's time-release properties by providing precise control of particle size and particle structure. When applied to drug-eluting stents, this characteristic should inhibit growth of tissue on the stent and result in longer stent lifetimes.

In addition, the e-RESS process offers more effective delivery of the pharmaceutical, particularly in cases where a combination of therapeutic agents is necessary to prevent restenosis.

More info: www.pnl.gov

World-class Auto Adhesive

In the automotive industry, the front-end carrier of a vehicle connects the upper and lower longitudinal body rails and plays a role in overall vehicle structural stiffness. Traditional steel front-end carriers are bolted or welded to the body. Adding subcomponents, however, requires welding attachment brackets, which increases weight and cost. Molded plastic front-end carriers, for their part, consolidate the number of parts being used as well as reduce weight and cost. However, in most cases, it still takes a hybrid structure of metal and plastic to resist loads on the carrier, particularly in a crash. To enable this hybrid structure, researchers at Dow Automotive, Auburn Hills, Mich., have developed **BETAMATE low energy substrate adhesive (LESA).** BETAMATE LESA is an adhesive that allows dissimilar materials, such as metals and plastics to be bonded in weight-bearing structural applications. The adhesive itself can be applied and cured at room temperature and requires no extra pressure during curing. These properties make the BETAMATE LESA a viable solution for replacing/supplementing welds and mechanical fasteners in the front-end carrier of a vehicle.

More info: www.dow.com

Multipurpose Carbon Foam

GrafTech International Ltd., Parma, Ohio, along with T Clear Corp., Hamilton, Ohio, have developed a new material, **GRAFOAM,** an open cell, rigid carbon foam that can be produced in a density from 32 to 560 kg/m^3. GRAFOAM has a uniform pore distribution size, which contributes to the high strength of the material and makes it easy to machine. It has a very high strength to weight ratio, and its temperature dependence is constant over its complete range of densities.

Low density GRAFOAM (32 to 80 kg/m^3) can save lives, reduce construction time, and reduce heating costs when used in fireproof panels in doors, walls, and floors. These panels can also withstand impact, insulate, and protect against sound and electromagnetic interference. High density GRAFOAM (240 to 400 kg/m^3) provides cost and flow-time reductions as a tool for large carbon composite parts used in the aerospace, marine, and automotive industries. It will also reduce the mass of tools, which in turn reduces handling issues with cranes, heat-up time in autoclaves, and rotational inertia which is critical in some applications.

More info: www.graftech.com

Affordable Alloy Production

The inherent properties of titanium, which include its light weight, superb specific strengths, overall high strengths, low thermal expansion, and superb corrosion resistance, make it a desirable material to use in aerospace, defense and transportation applications. However, state-of-the-art titanium processing is expensive.

To reduce this expense, researchers at Material and Electrochemical Research (MER) Corp. have developed **Low Cost Free Formed Titanuim Alloys (LCF-TiA),** an innovative process to produce near net shape titanium alloy components at approximately five times lower cost than traditional processing such as casting. LCF-TiA eliminates many costly steps and utilizes only two unit operations to produce a near net shape titanium alloy component.

The key to the LCFTiA process is the high ductility of primary titanium sponge, which easily forms and cold welds its surfaces together when deformed. The process feeds titanium sponge into sets of rollers and, through successive reduction steps, cold forms it into a wire shape. This wire is then fed into a plasma transferred arc and melted to form an alloy in one step. Components produced with the LCFTiA process have mechanical properties at least equivalent to standard conventionally produced, higher cost components.

More info: www.mercorp.com

Nanostructured Nickel

Nickel is important not only as a component of such materials as stainless steel and high-temperature alloys, but in its finer forms as a conductive filler. In order to enhance the useful properties of nickel, such as conductivity, magnetic properties, catalytic efficiency, and chemical stability, George Hansen of Metal Matrix Composites Company LLC, Midway, Utah, and William Jenkin of William C. Jenkin Company, Akron, Ohio, have developed **Nanostrands,** three-dimensionally interconnected, self-assembled lattices of sub-micron and nanostructured strands of nickel.

Nanostrands have two unique properties that allow them to perform better than competing materials: 3-D interconnectivity and a high degree of nanostructured branching. When dispersed into certain elastomers, Nanostrands increase conductivity by about two to three orders of magnitude under either slight compression or tension. The increase in conductivity under compression is well-understood and is observed in several other conductive additives, but the increase in conductivity under tension is unique to Nanostrands.

The principal applications of Nanostrands are those in which a lightweight polymer—or composite-based material is required, but where a level of conductivity approaching that of metal is also required. Such applications include electromagnetic interference shielding, electrostatic discharge protection, grounding/antennas, and lightning strike protection.

More info: www.nanostrands.com

Mitigating Metal Dusting

Degradation of metallic structural components by metal dusting has been a concern within hydrogen, methanol, and ammonia gas production lines for over 50 years. These industries have significant uncertainties about the mechanism that leads to metal dusting in their systems, and they have not been able to develop an approach to combat this corrosion. This scenario may soon change with the addition of **Materials Resistant to Metal Dusting Degradation,** developed by Krishnamurti Natesan and Zuotao Zeng at Argonne National Laboratory (ANL), Ill.

These new ANL-developed alloys perform significantly better than currently available commercial alloys when tested in a metal dusting environment because of their ability to develop oxide scales that are resistant to carbon attack. This breakthrough can lead to a complete redesign of reformers with improved efficiency, increased product yield, and decreased energy consumption. An estimated $220 - $290 million can be saved annually in the hydrogen industry alone. The ANL-developed alloys can also be used in other chemical and petrochemical industries and could lead to fewer maintenance shutdowns and higher productivity. With the current thrust toward a hydrogen-based economy, the long-range potential for the application of the new alloys is substantial.

More info: www.anl.gov