relative to conventional alloy powders;

• The energy storage capacities in alloy nanopowders are 40% higher compared to conventional alloy powders.

These results, reproduced at leading battery companies, have applications wherever high surface area electrodes, fast activation, or high power density is desired.

Encouraged by these results, NASA has invested an additional $600,000 with NRC to further develop and commercialize nanostructured alloy powders for hydrogen storage and hydride electrode applications. These funds will support nano alloy synthesis at NRC through March, 2000.

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Si-Polymer Composite Forms Passive Detector

With funding from the Air Force, Conducting Materials Corp. (CMC) of Columbia, MD is developing a passive infrared proximity detection device based on a silicon-polymer nanocomposite. The response time of the device has been demonstrated to be 20 milliseconds while a similar device comprised of micron-size silicon particles was not photoresponsive.

The role of a proximity detector in an air launched missile is to signal the missile's fuse to trigger detonation of its warhead when approaching the target. For supersonic missile-to-target approach velocities, proximity detection must begin when the target begins to fill the field of view of the missile's active guidance system, which occurs when the missile is within a few hundred feet of the target.

The objective of CMC is to incorporate into the missile a passive polymer nanocomposite microdetector array, in contrast to conventional active target detection devices that must first send out a signal to the target for proximity fusing. The silicon-polymer nanocomposite passive infrared proximity detector being developed by CMC is designed to detect photons that are naturally emitted from the target. Loadings of 60 to 70 wt.% silicon of about 50 nm in particle size have been incorporated into the polymeric matrix of CMC's passive microdetection device.

The advantage of using silicon-polymer nanocomposites for proximity detection instead of pure silicon, which also can provide passive detection capabilities, is that the former is flexible and shockproof while silicon wafers are very brittle. Furthermore, CMC's president, V. R. Paiverneker, says that the polymeric nanocomposite detector arrays are inexpensive, easy to fabricate, and lightweight with tailorable properties.

In addition to the company's work in this area, CMC has produced silver-polymer nanocomposites for EMI shielding applications. To obtain a given conductivity level from the nanocomposites, CMC found that the required particle loading level was reduced by a factor of two compared to composites produced using micron-size silver particles.

Another area of interest to CMC is the fabrication of ferrite components from Ni-Zn ferrite powders of 30 to 40 nm in size. The small particles have allowed sintering at reduced temperatures (e.g., 900°C compared to 1250°C) and the resulting ferrite components are characterized by relatively high densities and magnetic permeabilities.

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Nano Films Yield Bright Emission

Over the past several years Motorola and other companies around the world have been developing flat panel displays based on the field emission display (FED). The FED combines many of the advantages of its cousin, the cathode ray tube (CRT), including high brightness and contrast, wide angle viewability, and speed in a package that is merely a few millimeters in thickness.

The thinness and flatness of an FED are achieved by replacing the single thermionic cathode of the CRT with a matrix-addressed array of cold electron emission sources. Every pixel in an FED has its own set of cathodes, which are made up of hundreds of sharp, pyramidal-shaped metal microtips, called spindt tips. The high electric field required for field emission (~1 V/Å) is achieved by making the tips very sharp (the typical radius of curvature of the tips is less than 100 nm) and by surrounding each tip with a gate electrode only about 0.5 micron away.

While Motorola's first FED product will contain spindt tips, processing costs and challenges associated with the microtips have led Motorola to explore alternative "flat bottom" electron emitters. For example, one fundamental problem with the spindt tips is that the emitted electric field is radial in nature and thus a focusing electrode is required, which increases the cost of the device.

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