ciency in excess of 99%. The anode composed of the nanocomposite particles exhibited specific capacity in excess of 2,000 $mAhg^{-1}$ at the current density of 140 mAg^{-1} and excellent stability for 150 cycles, significantly exceeding the theoretical capacity of graphite and graphene. While only a Si-containing composite was demonstrated, the synthesis techniques utilized are applicable for other high-capacity materials that can be conformally coated on graphene. Similarly, while only curved graphene was used as a substrate for Si deposition, other curved, thin, 2D substrates (which do not react with Si precursors) may be used for conformal coating by Si or other high-capacity materials.

This work was performed by Gleb Yushin, Kara Evanoff, and Alexander Magasinski of Georgia Institute of Technology for Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steven Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18775-1

Ultra-Lightweight Nanocomposite Foams and Sandwich Structures for Space Structure Applications

Marshall Space Flight Center, Alabama

Microcellular nanocomposite foams and sandwich structures have been created to have excellent electrical conductivity and radiation-resistant properties using a new method that does not involve or release any toxicity. The nanocomposite structures have been scaled up in size to 12×12 in. (30×30 cm) for components fabrication. These sandwich materials were fabricated mainly from PE, CNF, and carbon fibers. Test results indicate that they have very good compression and compression-after-impact properties, excellent electrical conductivity, and superior space environment durability.

Compression tests show that 1000 ESH (equivalent Sun hours) of UV exposure has no effect on the structural properties of the sandwich structures. The structures are considerably lighter than aluminum alloy (≈36 percent lighter), which translates to 36 percent weight savings of the electronic enclosure and its housing. The good mechanical properties of the materials may enable the electronic housing to be fabricated with a thinner structure that further reduces the weight. There was no difficulty in machining the sandwich specimens into electronic enclosure housing.

This work was done by Seng Tan of Wright Materials Research for Marshall Space Flight Center. For more information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-32922-1.

Thermally Resilient, Broadband Optical Absorber From UV to IR Derived From Carbon Nanostructures

This technology can be used in aerospace, semiconductors, antireflection coatings, optoelectronics, and communications.

NASA's Jet Propulsion Laboratory, Pasadena, California

Optical absorber coatings have been developed from carbon-based paints, metal blacks, or glassy carbon. However, such materials are not truly black and have poor absorption characteristics at longer wavelengths. The blackness of such coatings is important to increase the accuracy of calibration targets used in radiometric imaging spectrometers since blackbody cavities are prohibitively large in size. Such coatings are also useful potentially for thermal detectors, where a broadband absorber is desired. Au-black has been a commonly used broadband optical absorber, but it is very fragile and can easily be damaged by heat and mechanical vibration. An optically efficient, thermally rugged absorber could also be beneficial for thermal solar cell applications for energy harnessing, particularly in the 350–2,500 nm spectral window.

It has been demonstrated that arrays of vertically oriented carbon nanotubes (CNTs), specifically multi-walled-carbon-nanotubes (MWCNTs), are an exceptional optical absorber over a broad range of wavelengths well into the infrared (IR). The reflectance of such arrays is 100× lower compared to conventional black materials, such as Au black in the spectral window of 350–2,500 nm. Total hemispherical measurements revealed a reflectance of ≈1.7 % at $\lambda \approx 1$ µm, and at longer wavelengths into the infrared (IR), the specular reflectance was ≈2.4 % at $\lambda \approx 7$ µm.

The previously synthesized CNTs for optical absorber applications were formed using water-assisted thermal chemical vapor deposition (CVD), which yields CNT lengths in excess of 100's of microns. Vertical alignment, deemed to be a critical feature in enabling the high optical absorption from CNT arrays, occurs primarily via the crowding effect with thermal CVD synthesized CNTs, which is generally not effective in aligning CNTs with lengths < 10 µm. Here it has been shown that the electric field inherent in a plasma yields vertically aligned CNTs at small length scales (<10 µm), which still exhibit broadband, and high-efficiency optical absorption characteristics from the ultraviolet (UV) to IR. A thin and yet highly absorbing coating is extremely valuable for detector applications for radiometry in order to enhance sensitivity. A plasma-based process also increases the potential of forming the optical absorbers at lower synthesis temperatures in the future, increasing the prospects of integrating the absorbers with flexible substrates for low-cost solar cell applications, for example.

This work was done by Anupama B. Kaul and James B. Coles of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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