Science & Technology Briefs

Structural Paint: A Coming Revolution in Colorants

In a March 9 study, published in *Science Advances*, journal of the American Association for the Advancement of Science, lead researcher Dr. Debashis Chanda, a professor at the University of Central Florida's NanoScience Technology Center, presents a revolutionary type of colorant which uses nanoscale structural arrangements of aluminum and aluminum oxide flakes, instead of pigments, to create colors.

Pigments are pulverized minerals, heavy metals, or chemicals that we mix into oil to evenly distribute over a surface. Cobalt becomes blue; ochre, red; cadmium, yellow. Some vivid colors on animals, however, are created from topography, not pigmentation. Submicroscopic landscapes on the outer surfaces of peacock feathers, beetle shells, and butterfly wings, for example, *diffract* light to produce what's known as *structural* color.

Mimicking Nature, the researchers combined tiny aluminum and aluminum oxide flakes with a commercial binder to form paints of all colors. Depending on the nanoparticle's size, its electrons will oscillate only for certain wavelengths of light, bouncing ambient light back as a fraction of what it was: a single color. Layering aluminum particles on a reflective surface amplifies the effect.

There are many advantages to this new type of paint, as stated by Prof. Chanda:

"In structural paint, the geometrical arrangement of typically two colorless materials produces all the colors. With man-made pigment, new molecules are needed for every color present."

"Normal color fades because, over time, pigment loses its ability to absorb photons. Here, we're not limited by that phenomenon. Once we paint something with a structural color, it should stay for centuries."

As plasmonic paint *reflects* the entire infrared spectrum, less heat is *absorbed* by the paint, resulting in the underlying surface being 25–30°F cooler than if it were covered with standard commercial paint.

Due to its large area-to-thickness ratio, with full coloration achieved at a paint thickness of only 150 nm, plasmonic paint is the lightest paint in the world. Because only about 3 pounds of plasmonic paint, for example, could cover a Boeing 747, which normally requires more than 1,000 pounds of conventional paint, using it will result in a significant fuel saving.

Prof. Chanda says his goal is to scale up production to make structural paint available at a cost lower than pigment-based paint. Meanwhile, structural paint is still in its early days and mostly being used in the lab, its revolutionary potential yet to be tapped.

U.S. Average Life Expectancy in Largest Drop Since World War II

For both 2020 and 2021, 9 out of the 10 leading causes of death in the United States were the same: Heart disease was first, then cancer, followed by COVID-19, and so on.

Last August, a preliminary report by the Centers for Disease Control and Prevention (CDC) indicated that in 2019, before the pandemic, life expectancy at birth was 78.8 years; and on Dec. 22, 2022, the CDC reported that in 2021, for the second year in a row, average U.S. life expectancy had declined to the lowest level since 1996. It fell to 76.4, in the largest drop since World War II. COVID-19 and soaring opioid overdosing were cited as the leading causes of death.

Every age group in the cited study saw a decrease in life expectancy, as did almost all ethnic groups, except for non-Hispanic Asian males and non-Hispanic black males, which saw only a slight decrease.

Although the CDC does not say so, both causes of death are markers of a society in collapse. We are killing ourselves by tolerating deadly policies.

Over 1.1 million Americans are reported to have died from COVID-19 since its beginning in early 2020. Another million-plus have died from drug overdoses in the last 20 years, with such deaths increasing significantly throughout the pandemic. The two causes of death are closely related according to Dr. Nora Volkow, Director of the National Institute on Drug Abuse:

"These data are very tragic but not surprising. The pandemic had a magnifying effect on an already-devastating overdose crisis, and exacerbated many of the stressors in society that make people more vulnerable to taking drugs."

The *Wall Street Journal* reported that U.S. drug overdose deaths increased five-fold over the past two decades. The surge in overdose deaths is attributed to the opioid fentanyl, now displacing heroin in many areas.

Deaths involving synthetic opioids, not including methadone, such as fentanyl, increased by 22% in 2021,

according to the CDC data. Fake prescription pills laced with fentanyl are one of the deadliest dangers. In 2021, the Drug Enforcement Agency found that some 42% of seized illicit pills contained at least 2 mg of fentanyl, a potentially fatal dose. By 2022, that had grown to 60%. As it reported Dec. 20, 2021, DEA agents had seized "over 50.6 million fentanyl-laced, fake prescription pills and more than 10,000 pounds of fentanyl powder that year. The DEA Laboratory estimates that these seizures represent more than 379 million potentially deadly doses of fentanyl—enough to kill every man, woman, and child in the U.S.

"With the arrival of new fentanyl substitutes and even deadlier hybrids, such as opioids laced with heroin, cocaine or methamphetamine, things could worsen sharply in 2023," warns former DEA Deputy Chief of Staff Jim Crotty, according to a report in *Sputnik News*.

Russians Building New City in Kherson Oblast

In Kherson Oblast, formerly part of Ukraine, Russia is building a new city. Many investors have already expressed interest in the development and infrastructure of the new city in Kherson's Arabat Spit, says Sergey Kiriyenko, First Deputy Chairman of the Russian Presidential Administration, as reported by *RT:*

"The Arabat Spit territory is, in my opinion, unique in terms of combination of natural and therapeutic factors. There will definitely be a resort area, but, I think, not only that. There are many opportunities for development: agriculture and modern scientific technologies. We must provide an opportunity to work here to architects, to people who live here, to companies that work here and to investors who come here. Very many are already interested in coming and investing in development, infrastructure, residence."

Previously, Vladimir Saldo, Acting Governor of Kherson, announced that the location chosen for the construction of the new city has good environmental conditions as well as road and rail connections. Construction will involve creating entirely new infrastructure. According to Saldo, the new city is planned to accommodate 30,000 people.

Discovery of a Previously Unknown Uranium Isotope

World Nuclear News reported on April 6:

"A team of nuclear physicists affiliated with institutions in Japan, Korea and the UK have reported the discovery of a previously unknown uranium isotope with atomic number 92 and mass 241. The new ^{241}U isotope was synthesized in the multinucleon transfer reactions of the ^{238}U + ^{198}Pt system at the KEK Isotope Separation System facility at the RIKEN Nishina Center Tokyo." The March 31 issue of *Physical Review Letters* published their work.

The same day, the American Physical Society's magazine *Physics* published the following report, titled "Exploring the Borders of the Nuclear Landscape":

"The properties of heavy, neutron-rich isotopes are poorly known, owing to difficulties in synthesizing these nuclei. Now Toshitaka Niwase at the High Energy Accelerator Research Organization (KEK) in Japan and his colleagues have helped to fill this knowledge gap. The researchers have directly determined the masses of 19 such isotopes, including a previously undetected uranium isotope, ^{241}U. These measurements will both test and refine existing nuclear models.

"Niwase and his team carried out their experiments at the KEK Isotope Separation System (KISS) facility in Saitama, Japan, accelerating a beam of ^{238}U nuclei into a rotating target of ^{198}Pt nuclei, thus transferring multiple nucleons—protons and neutrons—between the beam and target nuclei, forming the isotopes of interest. The researchers then studied these isotopes using time-of-flight mass spectrometry, a method in which an ion's mass is determined from the time it takes to travel a certain distance through a medium.

"The team obtained precise mass values for 19 heavy isotopes that contain between 143 and 150 neutrons: *For most of these nuclei, these are the first direct mass measurements. The researchers say that their use of multinucleon transfer reactions combined with time-of-flight mass spectrometry provides a new way to probe the boundaries of the nuclear landscape.* They also suggest that other combinations of beam and target nuclei could be used to synthesize and study nuclei possessing up to 154 neutrons." [Emphasis added.]

New Mineral Discovered on the Moon

According to a Sept. 12, 2022 posting on Space.com, Chinese scientists at the Beijing Research Institute of Uranium Geology have identified a new lunar mineral, naming it Changesite-(Y), after the Chinese goddess of the Moon.

The Changesite-(Y) crystal is columnar in shape, about 10 microns in radius, colorless, and semi-transparent, and is a member of the merrillite group of phosphate minerals. To identify the new mineral, the research team used a scanning electron microscope, which repeatedly confirmed and accurately located the mineral to be separated out of the surrounding basalt.