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Related Categories: Military Innovation; Science and Technology; Warfare; SPACE; NASA

SPACE SOLAR POWER-BEAMING ON THE HORIZON

As one of the country's largest consumers of energy, the Department of Defense has a strong interest in renewable energy sources. The U.S. Air Force in particular is working on developing power beaming — the capability to collect solar power in space and transmit the energy to other spacecraft, the Moon, or Earth (see *Defense Technology Monitor* no. 54) To that end, the Air Force Research Laboratory is planning to launch the *Arachne* spacecraft in 2024 as part of the service's larger Space Solar Power Radio Frequency Integrated Transmission Experiment (SSPRITE). According to the Air Force press release for the project, "*Arachne* will demonstrate emerging technologies that support the ability to convert solar energy to radio frequency (RF) power, using innovative 'sandwich tiles' as well as the feasibility of transmitting that energy to the ground and converting it to usable power." (*Popular Mechanics*, December 30, 2020)

ANOTHER STEP TOWARD ROBOTIC SPACE-BASED MANUFACTURING

The effort to develop autonomous space-based assembly and manufacturing capabilities continues to advance. In early January, COSM Advanced Manufacturing Systems announced that it is moving forward with the final development of electron beam 3D metal printing systems to support future space initiatives. COSM's project harnesses charged particle beam technology from the semiconductor industry and utilizes an electron beam that shapes metal from a spool of wire, with the process monitored and adjusted in real-time. According to COSM founder and CEO Richard Comunale, "producing large metal parts autonomously to verifiable specifications and quality in-space will be an enabling part of man's permanent presence on the Moon and further missions to Mars." COSM received funding for the project through NASA's Artemis program. (*PR Newswire*, January 6, 2021)

AUGMENTED REALITY ADVANCES

The Army's development of the Integrated Visual Augmentation System (IVAS), an augmented reality initiative designed to enhance warfighter domain awareness, continues to progress. IVAS, which grew out of a Microsoft initiative to develop virtual reality training headsets (for more, see *Defense Technology Monitor* nos. 36 and 48) is being used by the Army's Synthetic Training Environment Cross Functional Team (STE CFT) to enhance training for soldiers. In November, the Army completed the third of four major testing and demonstration exercises with IVAS. The test included soldiers from the Army's 82nd Airborne and Marines, who used the first militarized IVAS prototype to participate in a range of exercises such as land navigation, live fire, trench clearing, mission planning, rapid target acquisition, and after-action review.

The innovations are significant. According to Sgt. Loren Collins of the 10th Mountain Division, "When you get to walk through in real time, looking down on the virtual projection of what happened, you get to see things that maybe you didn't see while you're on the ground as a leader." The Army's goal is to deploy 40,000 IVAS platforms to soldiers by the end of fiscal year 2021. (*Fed Tech Magazine*, January 12, 2021)

HOW TEA IS INSPIRING TECHNOLOGY

Fermented Kombucha consists of tea, sugar, bacteria and yeast, which combine to make a fizzy drink that many claim cures ailments. Now, U.S. Army funded scientists at the Massachusetts Institute of Technology (MIT) and Imperial College London – inspired by kombucha fermented tea – have attempted to use bacteria and yeast cultures to detect pollutants and create self-healing substances. Imperial College London scientists isolated *Komagataeibacter rhaeticus* bacteria from a kombucha symbiotic culture of bacteria and yeast (SCOBY). Scientists determined that, when combined with *Saccharomyces cerevisiae*, a lab-grown yeast strain, *Komagataeibacter rhaeticus* can produce living materials that can be used for self-healing and to detect pathogens and pollutants. According to Dr. Jim Burgess, the program manager for the Army Research Office's Institute for Soldier Nanotechnologies, "our community believes that living materials could provide the most effective sensing of chem/bio warfare agents, especially those of unknown genetics and chemistry." Additional SCOBY applications include water purification, identification and destruction of pathogens, and creation of smart packing materials. (*Task and Purpose*, January 27, 2021)

THE FUTURE OF ARMOR: FISH SCALES?

When it comes to engineering developments, particularly in the defense realm, Nature has long served as a source of inspiration. In recent years, we have seen the Air Force attempt to apply beetle exoskeleton characteristics to enhance aircraft components (see *Defense Technology Monitor* no. 59) dragonfly decision-making influence missile defense algorithms (*Defense Technology Monitor* no. 44), and body armor that imitates pearls (*Defense Technology Monitor* no. 46) and fish scales (*Defense Technology Monitor* no. 47). Now, researchers have found inspiration in another fish: the tiny three-stripe cory catfish, which uses its tough armor to protect itself from predators such as piranhas. In a study by Chapman University, scientists found that the piranhas struggled to bite through the scales of the cory, which are composed of collagen and a strong, mineralized surface. Material engineers hope to review the nanostructure of the cory scales to develop lighter, stronger, and more flexible body armor. (*National Geographic*, January 21, 2021)