Australian Government

TRAVELING AT MACH 5: DEFENSE AND MATERIALS SCIENCE IN ACTION

Blink and you'll certainly miss it. Australian and US defense scientists have conducted two of 10 test flights of rockets that use revolutionary scramjet propulsion at the Woomera Test Range in South Australia. **The rockets travel at hypersonic speeds of more than Mach 5—that's well over 3,000 miles per hour.** More conventionally, an Australian-designed missile that masquerades as a ship has been selected to protect US aircraft carriers. **But it's not just rocket science where Australian and US collaborations have raced ahead.** Artificial intelligence research could see manned and unmanned aircraft fly in the same airspace. Australian materials have been incorporated into the latest American aircraft. **And quantum computers could soon be solving the knottiest of problems, now that Australian scientists have pointed the way to building them.**

Missile technology to protect Nimitz aircraft carriers

An Australian designed and developed decoy rocket, built with the help of the US, now protects hundreds of US, Australian and Canadian warships against incoming missiles.

Known as Nulka, it hovers in mid-air while seducing the incoming anti-ship rockets away from their target. It's Australia's most successful defense export.

In 2012, Nulka will be installed on one of the giants of the US Navy, the Nimitz-class aircraft carrier USS Abraham Lincoln, followed by the remaining nine Nimitz-class super-carriers. Nulka was invented by Australia's Defence Science and Technology Organisation (DSTO) and is made in Australia by BAE Systems Australia.

High-tech materials and alloys for the Joint Strike Fighter

The Australian company Ferra Engineering will be manufacturing titanium components for the F-35 Joint Strike Fighter using techniques developed in association with Australia's CAST Cooperative Research Centre. The two are now working with US manufacturer Lockheed Martin on developing laser machining for titanium to reduce costs further.

Australia also has a long history of expertise with composite materials. US aircraft giant Boeing manufactures many of its composite aircraft components in Melbourne including some for the company's latest aircraft, the 787 Dreamliner.

Fifty plastics patents

Joint research between CSIRO and US-based company DuPont for more than 20 years has generated over 50 patents. The association stemmed from a mutual interest in the formation of plastics, and has led to the innovative mechanism for generating purpose-built plastics known as RAFT (Reversible Addition-Fragmentation chain Transfer). Already this has led to new products such as environmentally friendly automotive paints and advanced photo imaging materials.

Diagnostic tear sensor

Melbourne company MiniFAB developed and now manufactures a disposable nanofluidic diagnostic tear sensor for TearLAB Corporation of San Diego. The sensor is used to diagnose dry eye disease, a disorder that affects millions of people worldwide and can be severely disabling.

Scramjet technology

The Hypersonic International Flight Research Experimentation (HIFiRE) project undertaken jointly by the US Air Force Research Laboratories and DSTO is exploring the rigors, needs and possibilities of hypersonic flight for both military and civilian purposes. It could make air travel between the two countries a matter of a few hours.

Scramjet technology uses available oxygen in the atmosphere to burn fuel in an air flow travelling at supersonic speeds. That means the scramjet doesn't have to carry oxygen as a component of its fuel, which should help it reach a projected top speed of between Mach 12 and Mach 24. Already, Australian and US researchers have achieved Mach 10.

At present, the scramjet rockets fire only for a few seconds, but the researchers hope to make that a minute or more, demanding new materials to withstand the heat. In parallel with HIFiRE, another international consortium, headed by the University of Queensland and including the University of Minnesota is investigating the development of Scramjet technology for civilian purposes.

Switching to autopilot

Artificial intelligence is at the heart of the Smart Skies initiative to develop the technology that will allow manned and unmanned aircraft to fly in the same airspace. Based in the state of Queensland, the project brings researchers from Boeing in the US and Australia together with specialists from CSIRO, the Australian Research Centre for Aerospace Automation and the Queensland University of Technology.

Practically, they will seek to develop enabling technologies including an automated separation management system for aircraft, robust collision avoidance systems, and mobile aircraft tracking systems. Trials already are being conducted in Queensland.

Wedgetail AWACS

Boeing and CSIRO have had a partnership which extends well over 20 years, and involves joint research in the areas of advanced materials, complex systems, information and communication technologies and advanced platform systems, such as developing the Australian version of the US Airborne Warning and Control System (AWACS), known as Wedgetail.

CSIRO has a permanent representative seconded to Boeing in Seattle, and Boeing has a permanent branch of its advanced research and development unit in Australia, Boeing Research and Technology-Australia.

A new synchrotron and a research reactor

For many years Australian scientists packed up their experiments and headed to Argonne National Laboratory and other large American facilities. Today, Australia has an enviable suite of large facilities of its own. The Australian Synchrotron in Melbourne and Open Pool Australian Lightwater (OPAL) research reactor in Sydney together represent an unprecedented investment by Australia in major research facilities for materials research. Synchrotron x-ray and neutron beam techniques are complementary for materials analysis and novel materials development, giving information from atomic scale to macroscopic materials properties such as stress and strain.

The area surrounding Monash University in Melbourne's southeastern suburbs is developing as a significant concentration of materials research. It not only contains the Australian Synchrotron, but also several CSIRO divisions focused around materials science. The research arms of many materials-based companies are located nearby, and the University itself supports much materials-related research.

Putting nuclear waste in its place

Early in 2010, the US Government announced a decision to use Hot Isostatic Pressing (HIP) technology to treat reprocessed defense waste at the Idaho National Laboratory (INL) site. This decision followed two years of paid demonstration testing that Australian Nuclear Science and Technology Organisation (ANSTO) had performed for the US Department of Energy (DOE) to validate the efficacy of ANSTO's HIP technology.

This technology is a central part of the Synroc process that can be tailored to immobilize a wide variety of radioactive wastes. Synroc is a ceramic material made from natural minerals which together can incorporate into their crystal structures nearly all of the elements present in the different types of high level radioactive waste. ANSTO also operates the OPAL research reactor in Sydney's south. HIP technology will save the US Government billions of dollars.

IMAGE CREDITS: US AIRCRAFT CARRIER USS NIMITZ, WHICH WILL BE PROTECTED BY NULKA, U.S. NAVY/JAMES MITCHELL;
BOEING'S WEDGETAIL AIRCRAFT, RAAF/CPL CLINT MCKAY; AT WORK ON THE HIFIRE SCRAMJET TESTBED, UNIVERSITY OF QUEENSLAND;
F-35 LIGHTNING II FIGHTER AIRCRAFT, USAF/JULIUS DELOS REYES.

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