FOR IMMEDIATE RELEASE

Body armour and protective sports padding made from cornstarch solution?

- *Based on the same principles of how a cornstarch solution hardens on impact, Singapore researchers have invented a new flexible, lightweight, impact-resistant composite material.*

Not quite body armour made out of cornstarch but scientists from Singapore Agency for Science, Technology and Research's (A*STAR) Institute of Materials Research and Engineering (IMRE) and the National University of Singapore have used the same scientific principles to invent a new made-in-Singapore lightweight, flexible, and simple to make composite material capable of dissipating high impact energy.

The 'smart' material is soft and can conform to the shape of irregular surfaces. It is form-fitting and offers a high degree of comfort and mobility to wearers but instantly stiffens upon impact to protect the person from knocks and falls, shrapnel from explosives, or injuries from weapons such as clubs. The material can withstand high-impact loads, will not crack under repeated loading and can even float on water.

Tests have shown that the new composite material is more effective than commercially available protective foams (used in sports) of greater thickness in dissipating impact energy. A 2cm thick version of the new material is comparable in performance to hard ceramic or steel plates when worn as a protective pad behind ballistic vests to reduce blunt trauma injuries. This could be used to replace the thick, heavy steel plates that are worn beneath Kevlar armour, thus improving mobility and comfort for the wearer.

The material is a composite which consists of a polymer and a combination of other materials engineered through a patented method developed in Singapore. It works based on the concept of shear thickening, meaning the material is soft and fluid at rest but becomes rigid upon impact, just like a cornstarch solution. When moved gently, the molecular chains that hold the material together can 'slide' past one another, hence giving the material a soft consistency. In other words, the material will bend and flex smoothly under lightly applied force. But hit it or make sudden movements and the molecular chains do not have time to react properly and become entangled turning the material rock-solid. Similar shear thickening fluid-based materials technology involves encapsulating it within a foam matrix. The secret to the new IMRE-NUS material lies in how it's made - with a patented method that not only allows it to be more flexible and soft without the need for foam encapsulation, but also helps the material spread out high-impact force much more effectively and quickly than other products.

"The idea for the new material came to us when we were demonstrating a popular cornstarch science experiment during our regular Science Outreach to the public to show the versatility of materials", says Dr Davy Cheong, a Senior Research Engineer with IMRE and member of IMRE's Science Outreach team, who co-invented the material with partners from NUS, Mr Phyo Khant and A/Prof Vincent Tan Beng Chye.

"The technology has huge potential in the protective body armour industry, particularly in the sports arena where blunt force trauma accounts for a significant

portion of sports-related injuries", adds Dr Cheong. "What we have here is a softer, more flexible padding that absorbs more impact but doesn't hinder movement, which ultimately improves an athlete's performance".

The technology can be applied to a number of areas, including body armour, sports protective equipment, surgical garments, and even aerospace energy absorbent materials. IMRE is now looking for industry partners to help evaluate and scale-up the technology.

Encl. **Annex A:** Corporate Profiles

Annex B: Shear Thickening Fluid Technology and Images

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Annex A – Corporate Profiles

About the Institute of Materials Research and Engineering (IMRE)
Established in September 1997, IMRE has built strong capabilities in materials analysis, characterisation, materials growth, patterning, fabrication, synthesis and integration. IMRE is an institute of talented researchers equipped with state-of-the-art facilities such as the SERC Nanofabrication and Characterisation Facility to conduct world-class materials science research. Leveraging on these capabilities, R&D programmes have been established in collaboration with industry partners. These include research on organic solar cells, nanocomposites, flexible organic light-emitting diodes (OLEDs), solid-state lighting, nanoimprinting, microfluidics and next generation atomic scale interconnect technology.

For more information about IMRE, please visit www.imre.a-star.edu.sg

About the Agency for Science, Technology and Research (A*STAR)
The Agency for Science, Technology and Research (A*STAR) is the lead agency for fostering world-class scientific research and talent for a vibrant knowledge-based and innovation-driven Singapore. A*STAR oversees 14 biomedical sciences, and physical sciences and engineering research institutes, and seven consortia & centres, which are located in Biopolis and Fusionopolis, as well as their immediate vicinity.

A*STAR supports Singapore's key economic clusters by providing intellectual, human and industrial capital to its partners in industry. It also supports extramural research in the universities, hospitals, research centres, and with other local and international partners.

For more information about A*STAR, please visit www.a-star.edu.sg.

Annex B – Shear Thickening Fluid Technology and Images

Protective Gear and Armour is Big Business

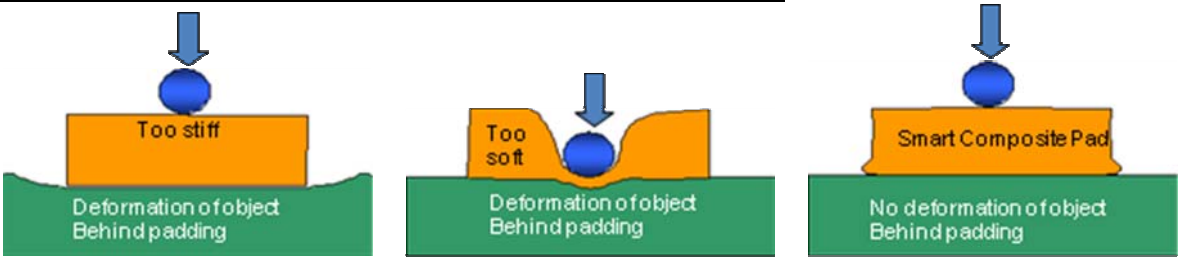
Source: [BCC Research: Advanced Protective Gear and Armor, 2007]

- The U.S. market for advanced fire protective clothing, armour, biological/chemical protective clothing, and respirators, gloves and other ancillary protective gear was worth $3.3 billion in 2007. This is expected to increase to over $4.5 billion in the next five years, a compound average annual growth rate (CAGR) of 6.6%. The largest single segment, 60%, of the 2007 protective gear and armour market is in the ancillary gear market.
- Body and vehicular armour is currently a $404 million sector that will see a 10% compound annual growth rate over the next five years.

Applications for Technology

- Personal Protective Equipment - e.g. Body armour, shoes for construction sites, military armour, anti-fragmentation protective clothing, blast attenuator, etc.
- Sports equipment - Protective garments / gloves for high impact sports (e.g. skiing, racing, football, biking, skateboarding,)
- Packaging - Protective material for flexible electronic devices subjected to fragmentation
- Medical application - e.g. Surgical garments, hip protection, orthopedic accessories, etc.
- Energy absorbent materials for Spacecraft / Aircraft / Automobiles

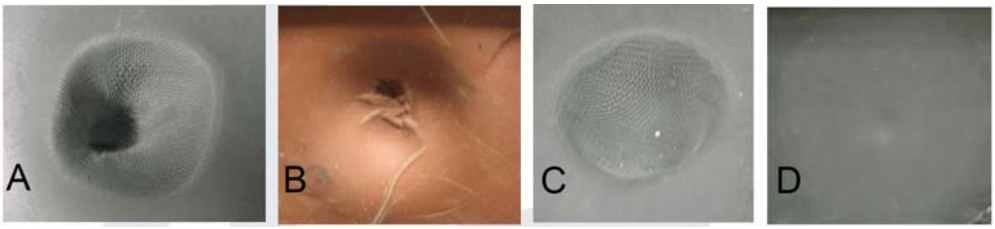
Features and How it Compares to Existing Technologies



Conventional Material A ***Conventional Material B*** ***IMRE's Smart Composite***

IMRE's patented material is designed for:

- ***Absorbing high impact energy*** – Due to unique deformation behaviour of composite material.
- ***Comfort*** - Flexible and can easily conform to any shape. It can be used to wrap around any structure or used to protect parts of objects where mobility is required.
- ***Toughness*** – Able to withstand high impact loads without breaking and does not crack under repeated impact.
- ***Lightness*** – Composite material is light weight and floats on water.



Indentation in clay due to steel sphere impact on (A) 20 layers of commercial ballistic fabric (X) (B) 20 layers of X backed with 2 cm thick rubber pad (C) 20 layers of X backed with another 20 layers of X (D) 20 layers backed with 2 cm thick IMRE smart composite pad.