## Intelligent fabrics protect and improve athletes' performance

## 智能織物保護及提升運動員表現

rof. Li Yi of the Institute of Textiles and Clothing and his research team have designed and engineered collections of sportswear by integrating multidisciplinary sciences, technologies and arts to meet the biological, physiological and performance requirements of various sporting activities under different environment conditions.

By developing a scientific understanding of the thermal biological, biomechanical and air dynamic characteristics of body motion in various sports, novel body mapping functional design concepts were developed with localized functional mapping for thermal management. biomechanical supporting, air drag reduction and injury prevention (photo 1 & 2).

The designs were realized by applying advanced clothing functional CAD technology, and textile and clothing manufacturing technologies such as dynamic patterning and advanced seamless garment fabrication technologies. The researchers evaluated the functional performance of the design collections by testing the physical properties of fabrics and conducting trials to validate the thermal management, body compression, protection in low limb, fatigue reduction of the main loading muscles and air drag reduction. They also considered aesthetic elements such as colour, form, texture and proportion, integrating them with the functional design, which illustrates the fusion of fashion, art, use but becomes rigid instantly under impact to technology and science.

elite athletes at the 2008 Beijing Olympics, 2009 East Asian Games, 2011 Asian Rowing Championships and 2012 London Olympics. The group's M POWER running wear and S POWER cycling wear won the China Successful Design Award in Shanghai in 2011 and the Golden Prize in the 5th Qiaodan Cup International Sport Equipment Design Contest in 2010, respectively. The design innovations have also been any size and shape.

adopted by well-known brands to develop a new generation of high-performance sportswear

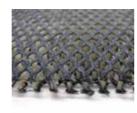
Another researcher, Dr Hu Hong, Associate Professor, has invented a novel kind of intelligent impact protective material that can be used to produce impact protectors for energy absorption and impact spreading. The material can be integrated or inserted into protective garments or equipment for protecting the human body from strokes, blows or falls in impact sports (photo 3 & 4).

The most commonly used impact protectors are made from polyurethane foams and thermoplastics, but are not comfortable due to their low flexibility, air permeability and moisture transmission. However, Dr Hu's intelligent impact protective material is based on 3D warp-knitted spacer fabrics finished with impact hardening polymer. The 3D spacer fabrics are constructed with specially designed hexagonal mesh structure, and the impact hardening polymer is synthesized using silicon-based materials with the addition of nano-particles to enhance its ability to absorb and dissipate energy

The newly developed 3D auxetic spacer fabrics can transversally expand when stretched, making them fit very well with the body's shape, especially around knees and elbows. In addition, Dr Hu developed a stress-responsive, impact-hardening polymer. This polymer remains soft in normal prevent the concentration of impact force and to maximally absorb and dissipate the impact The design collections were used by Hong Kong energy. After impact, the polymer immediately

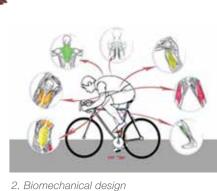
> The new intelligent impact protectors have a few important advantages. They exhibit high performance in their impact protection and excellent comfort due to high air permeability and flexibility, and are easy to use and care for because they are washable and can be cut into











生物力學設計

Researchers at PolyU's Institute of Textiles and Clothing have developed high-performance sportswear and fabrics to enhance the performance of sportspeople and dissipate impact force during sporting activities.

理大紡織及製衣學系的研究人員開發出高性能的運動服和織物, 以提升運動員的表現和在運動的過程中消滅衝擊力。

4. Sportswear made of intelligent impact protective 3D spacer 由三維智能防衝間隔織

物製成的防衝運動服裝



能等多方面的需求。 研究團隊建立了紡織服裝生物工程理論體系,並運 用於人體在不同運動時的運動屬性研究,包括生物 熱生理特性、生物力學特性及空氣動力學特性等,

研發出原創性的 「服裝人體生物功能匹配設計 | 專

利技術(圖1、2)。

技與科學相融合的概念。

「服裝人體生物功能匹配設計 | 的概念通過應用先 性、生物力學特性及空氣動力學特性。同時,美學 素亦與功能性設計相結合,顯示出時尚、藝術、科

該設計系列被用於支援裝備香港精英運動員,包 消散衝擊力。衝擊過後,聚合物立即恢復柔性。 倫敦奧運會。其中,「M POWER」跑步服於二零 - 年在上海「中國最成功設計 | 大賽中獲獎,而 並且可洗可裁剪,易於使用和護理。��

「S POWER」自行車服亦在二零一零年第五屆喬 不同環境下進行不同體育運動時在生物、生理和性 新一代高性能運動服

> 另一方面,副教授胡紅博士開發了一種嶄新的「智 能防衝材料 | 。這是一種能量吸收織物,可以用於 衝擊防護服或裝備,保護人體在創傷性運動中免受 衝擊,打擊或跌倒的傷害(圖3、4)。

> 現有防衝護具都是由聚氨酯泡沫和熱塑性塑料製 亦較低。然而,胡博士開發的「智能防衝材料」是 由三維間隔織物和衝擊變硬聚合物複合而成。間隔 織物具有三維六邊形網格結構,衝擊變硬聚合物則 由有機矽和納米顆粒複合而成,以提高其能量吸收

> 新開發的三維間隔織物在縱向拉伸下向橫張開, 衝擊時, 此聚合物會保持柔性, 但當受硬物衝擊時 就會即時變硬,避免衝擊力集中,從而盡量吸收及

這種智能防衝織物具備多項優點,除高防衝防護性