

# Technology Frontier

News Bite on PolyU's Innovation

## Innovative Spinning System for Chitosan Yarn

Making a durable, economical and multi-bio functional yarn  
out of crustacean shells

Chitosan, a substance extracted from crustacean shells, has huge potential to be an ideal material for clothing, medical dressings and military uniform because of its wearing comfort, antibacterial and wound healing properties. However, chitosan fibre is fragile, expensive and prone to technical problems in the production process. As researchers from the Institute of Textiles & Clothing invented a new spinning system for chitosan yarn that solves all technical problems, chitosan-based fabric is deemed to take the market by storm in the near future.



Dr Li Li (right) and her project team member

Putting some crustacean shells on your body doesn't necessarily mean you're in the cast of Little Mermaid on stage or dressing up for Halloween. Maybe you just want to smell fresh after a day of intensive workout. Chitosan, a substance extracted from the shells of crabs and shrimps, has natural antibacterial and anti-microbial properties. Clothing made with chitosan doesn't stink even if drenched in sweat all day because the bacteria that cause foul smell cannot survive on the fabric. "Chitosan seems to be the perfect fibre for apparel - it is soft to the touch, breathable, non-toxic, odour-free and hypoallergenic. Chitosan also promotes wound healing and skin cell regeneration. That means it makes biocompatible

wound dressing and military uniforms too," said Dr Li Li, Associate Professor, the Institute of Textiles & Clothing.

However, chitosan fibre creates some technical problems on production level which stop it from being a popular fabric material. For this reason, Dr Li and her research team invented an innovative spinning system that solves all technical glitches related to chitosan fibre. Dr Li believed that the new system would help chitosan-based fabric secure more market presence in future.

### Spinning chaos

Despite its highly desirable qualities, chitosan clothing hasn't caught on, mostly because of its



Chitosan yarns spun with the new spinning system can be made into high quality fabrics and garments.



Treated crustacean shell (lower left) is the raw material of chitosan fibre (lower right).



The Innovative Spinning System for Chitosan Yarn won a gold medal in the 44th International Exhibition of Inventions of Geneva.

staggering price, its fragile nature and its tendency to generate static electricity. Dr Li explained, "Before being made into clothing, fibres need to be spun into a yarn which is then woven or knitted into fabric. However, when chitosan fibres are spun on a regular machine, the friction between fibres and the spinning roller generates static electricity. The fibres break and cling around the roller. Such clinging fibres would stop the spinning machine automatically. Meanwhile, as all the fibres carry the same electrical charge, they repel each other just like two magnets with the same pole. These problems not only undermine the quality of the yarn, but also hinder productivity and incur high wastage cost." As a result, Dr Li and her research team developed a spinning system for chitosan yarn.

To tackle this problem, the team have specially created a conductive spinning rollers. "When the roller is conductive, any static electricity generated on the fibres will be conducted away." said Dr Li. Thanks to the new system, 100% chitosan yarn can be produced with strength and properties comparable to commercial yarns. Meanwhile, wastage is reduced significantly, hopefully bringing down the prices of chitosan yarn and fabric in future.

### Balancing between cost and function

Last but not least, chitosan is expensive. It costs as much as RMB 800,000 per ton – almost as

expensive as cashmere and well over 10 times more expensive than cotton or linen. To bring the price down, Dr Li and her team experimented by blending chitosan with other fibres. "Our team ran tests on 100% and blended chitosan yarns and analysed how the percentage of chitosan content affects their bio-functions and mechanical properties. With such data, manufacturers may strike a balance between cost and performance, according to the specific requirements of their products." she said.

For sanitary and sports textiles, the team looked at the antibacterial performance against chitosan percentage. They found that the more chitosan a yarn contains, the higher its ability to suppress microbial growth. Similarly in wound dressing or bandage, wound healing property is crucial and results showed that the more chitosan there is in the yarn, the faster a wound heals. When applying chitosan to healthcare products, especially for those with sensitive skin, softness and comfort matter. The team also found that blending chitosan with cotton gives good wearing comfort. With a lower cost and better performance, the widespread use of chitosan-blend yarn and fabric is deemed to come true soon.

In April 2016, the Innovative Spinning System for Chitosan Yarn won a gold medal at the 44th International Exhibition of Inventions of Geneva, Switzerland.