

“Steam blasting” with real gold

Empa researchers are writing fashion history with a vacuum coating system. Using high tech methods, they can produce a yarn with a layer of pure 24-carat gold. This spring, the material will have its premiere on the catwalk of an haute couture collection; a line of neckties is already available.

TEXT: Rainer Klose / PICTURES: Empa; Vincent von Ballmoos



Project manager Martin Amberg is looking through a peephole inside his coating system, obviously pleased, even though there's really not much to see. Violet light fills the interior of the apparatus roughly the size of a home refrigerator. Threads are strung up side by side in the machine and move past the peephole.

The violet light emanates from a piece of gold which is degraded into its atoms by high-energy radiation. The result emanates from the other end of the apparatus. A thin tube, almost like a straw, points upwards; from its top, a

thread is pulled out and wound on a bobbin. The coiled thread shines with a golden hue in the sunshine coming through the window into this industrial building.

In an adjoining room at the Tersuisse spinning mill in Emmenbrücke, with Empa's assistance, a world's first is taking shape: a fibre with a 24-carat gold coating. Fabrics woven from it sparkle with the characteristic colour of this precious metal, but they don't require customers to make any compromise. The fibres have a soft feel, are abrasion-proof and can even be safely put in a

washing machine. This fibre has been in production since summer of 2011. The first batch went to the spinning mill at Weisbrod-Zürcher AG in the town of Hausen am Albis, where it is processed together with black silk into material intended for ties. Starting with a panel of fabric which contains 25 grams of gold, it is possible to make three ties, a bow tie and a pocket handkerchief. It goes without saying that such products are not an inexpensive indulgence.

But how does the gold get on the fibres? Empa researchers decided to use a process called magnetron sputtering. For this, they require only a bit of electricity, a medallion made of gold, a few litres of argon gas and a vacuum container large enough to unwind 4,000 metres of thread in narrow loops. Anyone who has assembled all this can vaporise gold at room temperature and fabricate gold thread. Inside the coating system, the gold piece, called a target, is bombarded with fast-moving argon ions. Atoms of gold are “knocked out” and deposit themselves on a polyester thread, which is pulled slowly through the machine just a few centimetres from the target.

Of course, things aren't quite that simple, the devil is in the details: for instance, how the polyester thread has to be prepared so that gold actually sticks to it, which operating voltage and layer thickness yield the best effect – all trade secrets. When the first proud owners will put on their gold ties at Christmas of 2011, this moment will mark the culmination of a 10-year research project. That's how long textile experts at Empa in St. Gallen have been testing and refining the magnetron sputtering method. To gain systematic experience, they sputtered all sorts of metals – titanium, aluminium, steel, copper and silver – and let them rain onto various fibres.

The project's goal was initially a thread of silver, which immediately found a number of markets. Silver-coated fibres have an antibacterial effect, something of interest to, for example, clothing manufacturers who use it to make odour-free socks. In addition, fashion designers were looking for durable silver-coated textiles. Furthermore, silver conducts electricity extremely well, making the Empa-developed fibre extremely well suited for use in various sensors and as an antistatic filter material for industrial applications. “What is possible with silver might also work with gold”, the project partners thought to themselves. So in January 2010 they started working on “Project Gold Fibre”.

There were, however, many problems to be solved. How much gold is necessary to make the threads shine? Does a base of silver improve the sheen? Can silver and gold be applied in the same stage, thereby allowing an “alloy” to be manufactured directly on the thread? The result of a series of tests showed that an amount of 3 grams of pure gold per kilometre of thread produces a lovely sheen in





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a discrete antique shade of gold. Further, if the base is made of silver, the gold shines considerably brighter; the colour is as striking as on a large piece of gold jewellery. The silver layer can be applied in the same process stage if gold and silver targets are inserted next to each other in the machine and are bombarded simultaneously. Thus, a gold coating can be manufactured for a wide range of fashion accessories and various tastes. While a businessman might want a tie in a discrete antique gold, it might be desirable to have the delicate embroidery on a woman's evening gown shine somewhat brighter.

After 24 months, Project Gold Fibre is reaching a successful conclusion. The further processing of the yarn is being taken over by two partner companies who were involved in the project from the very beginning: Weisbrod-Zürcher and the embroidery and decorative material factory Jakob Schlaepfer in St. Gallen. A limited series of gold ties is already on sale for the Christmas season. Because of the limited amount of available gold fibre, there will only be a dozen gold ties for affluent customers around the world. Exclusivity, a precious material and high-tech production methods have their price – a buyer must come up with 7,5000 Swiss francs for a tie. For this price, though, he can be assured that he is wearing roughly eight grams of pure gold.

In future, too, the gold ties won't be going into mass production. At full capacity, 600 pieces could be manufactured annually. Certainly, though, it will be far fewer because a part of the fabric production is being reserved for the second project partner, Jakob Schlaepfer, who plans on using the golden fabric for its winter 2012/13 haute couture collection, which will be presented this spring. //



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Project leader Martin Amberg monitors the vacuum-coating system, in which a simple polyester thread is "transformed" into a true gold thread. Bottom photo: a silver target that has already been used. Bombardment with argon ions etches a circular groove in the metal.

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On location at the Hofmann tie plant in Zurich: the gold fabric consisting of gold threads and black silk is cut by hand and sewn into an elegant tie. Bottom photo: Martin Amberg and textile engineer Chokri Benkhalel Kasdallah are very pleased with the result of their efforts.



Video:
Gold-plated clothes

http://tv.empa.ch/empa_tv_goldkrawatte_20111201.m4v
For smartphone users: scan the QR code
(e.g. with the "scanlife" app)