Averatek

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Metallization of Fabrics

A variety of innovative methods have been developed over the last almost 100 years to metallize textiles and fabrics. This is one of the most emerging products with applications ranging from aesthetics, sensors and wearable devices and is projected to grow at a logarithmic rate in the coming years. Several methods to metallize textiles and fabrics have appeared in literature. Averatek has developed a unique low cost atomic deposition technology to address this promising and upcoming market.

EARLY ENDEAVOURS TO METALLIZE TEXTILES AND FABRICS

The urge to metallize the fabrics was motivated by aesthetics and water proofing and is reported in a British patent (1924) [1] which describes using a metal polymer mix coating on fabrics to impart the desired water proofing ability to the fabric. Graphitized fabrics for galvanic coating of precious metals was also developed[2] (1931). An art of metallizing fibers by redox precipitation of silver and fixation using binders has also been described in early reports, e.g., Karl[3] (1924). A superior method of providing lustering metallic coating of metals on fabrics by treating the fabrics with metal salt solutions followed by appropriate reducing agents to deposit metal on the fabrics and subsequent treatment with a lustering machine was invented by Trebitsch [2].

RECENT APPROACHES

Metal deposition by Plasma and sputtering

Plasma[4] and sputtering[5]techniques have been relatively recently developed and used to deposit thin layers of metals on textiles. Unarguably these are technically complex and economically expensive techniques for metallization and are necessitated if metals like steel, titanium, etc., are required to be deposited, as the deposition of these metals is not entertained by wet chemistry methods.

Metal deposition by wet chemistry methods

With the development of wet chemistry approaches to deposit metals from solutions of metal salts, low cost and efficient chemical techniques are being used to apply metal-coatings on fibers and textiles. These can be mainly divided into two categories, (1) direct precipitation of metal particles on fibers and textiles from solutions without a catalyst and (2) deposition of metals on fibers and textiles from solutions of metal salts that have been coated with a catalyst (palladium).
Both these techniques are being developed aggressively for obtaining consistent and robust metal coatings on fibers and textiles for several applications. The non-catalytic approaches of category (1) have been described in detail for textiles and fabrics including PET [e.g., 6, 7,8.] based on the fundamental concept initially visualized

by Trebitsch (*loc. cit).* The use of a catalyst, notably colloidal palladium for electroless deposition of metals from solution of metal salts has also been successfully explored for metallizing textiles and facbrics[9, 10].

Metal deposition using meal powders and binders

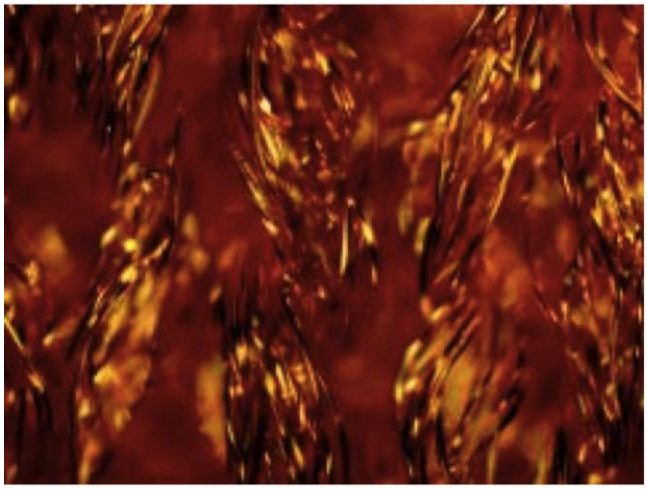
Kuhn et.al.[11] describe a method of metallizing textile fabrics by using metal powders and binders and in concept this approach is a modified approach initially conceived in a British patent[1.]

Averatek's singular approach of the use atomic palladium catalyst for fabric metallization

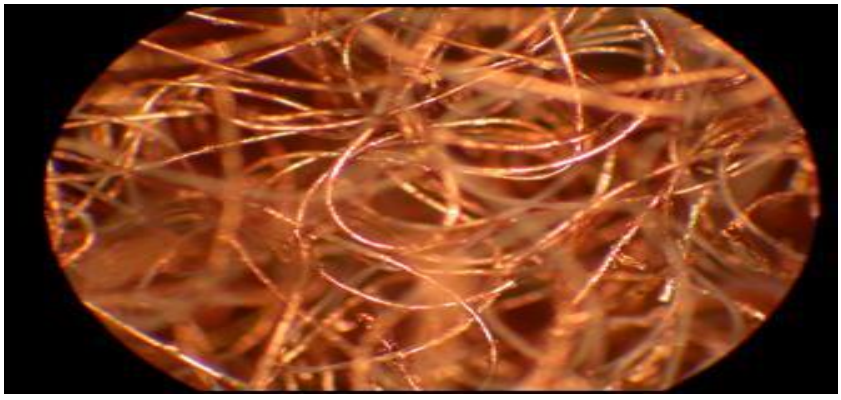
Averatek has designed a very low cost non-vacuum atomic palladium deposition technology for metallization of a variety of substrates that includes textiles and fabrics including nylon, PET or other polymeric materials, plastics, ceramics, composite materials, glass, paper, and several porous and non-porous media[12,13,14,15]. The deposition of atomic palladium has been authenticated by TEM of the palladium films.

The size of metal particles decreases in the following order, colloidal>nano>atomic. The catalytic activity usually increases as the size of the catalyst particle decreases. The use of colloidal palladium is now being gradually substituted by nano palladium as it affords superior electroless deposition of the metals. Averatek's atomic palladium has exhibited extraordinary catalytic activity not only for electroless deposition of metals for circuitaztion on flat and conformal substrates but also for several other applications that include corrosion protection coatings, general catalysis, etc. We have successfully utilized atomic palladium on textiles, fibers (including cotton, nylon, Kevlar ™) for field metallization and patterning of these substrates. The following pictures represent metallized cloth and Velcro:

Copper coated cloth



Microscopic picture of the copper coated fiber (80x)

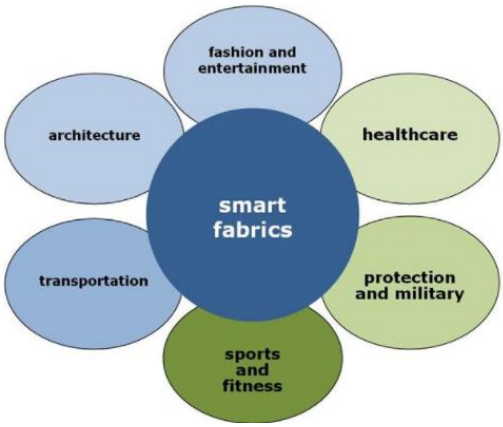


Copper coated Velcro

Averatek is enthusiastically pursuing various applications for this technology.

Prominent applications of metallized textiles and fabrics

Metallization of fabrics is being driven by several applications that include but not limited to (1) Smart fabrics and wearable technology[16] (2) Military, (3) EMI/RFI shielding, (4) Decorative, (5) Cosmetics and glamour, (6) Antibacterial, (7) Medical sensors such as sweating, monitoring heart rate, breathing etc., and (8) Automotive, to name a few.



Applications of smart fabrics

Following are a few examples illustrating some of the applications of smart textiles:
The denim jacket is the first of its kind and makes use of 'Project Jacquard' technology, which has been in development by Google since 2015. These conductive yarns can then be connected to a tiny circuit, no larger than a button, creating data which can be wirelessly transmitted to mobile phones and other electronic devices.

Smart Jacket

The technology combines thin, metallic alloys with natural and synthetic yarns to create touch-sensitive interactive fabrics. The following pictures exhibit a few exotic applications:

Seamless integration of sensors with fabrics:

Sensors embedded in socks

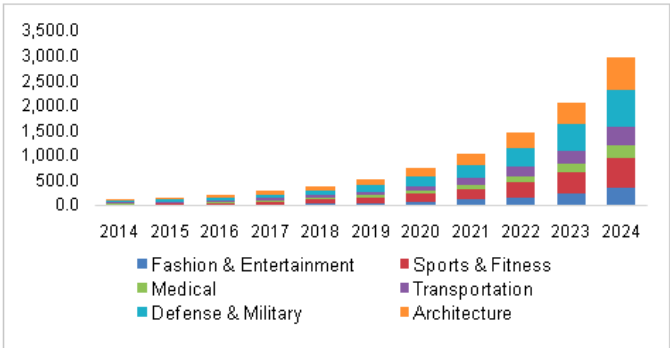
Smart fabrics in fashion and entertainment

Super light and flexible circuits for wearable computers

Industry drivers and market

Metallized textiles are projected to $9.3 billion by 2024 (Markete Research Report from Grand View Research).

Europe Smart Textiles Market By End-Use, 2014 - 2024 (USD Million)



There are a number of key players who are targeting this fast growing market, e.g., Google, Levis, Sensoria, and several more.

Conclusion:

Electronic and smart textiles and fabrics is a fast developing technology and is projected to grow at a very fast rate in the coming years. Averatek has a unique enabling technology to field and pattern metallize a variety of fabrics, textiles and plastics such as buttons, zips, hooks etc., at a very competitive cost that can be used for superior functionality.

Literature Cited:

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