

Cotton surface modification and functionalisation

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This study used visual representation techniques to explore relationships between cotton fibre properties and current approaches for modification and functionalisation of the cotton surface. The literature on relevant topics was reviewed to establish the conceptual framework, and the information was organised thematically and hierarchically. Mapping techniques were then applied to convert the information into a visual form.

Intrinsic properties of cotton make it one of the most used textile fibres. This popularity is greatly driven by consumers' demand for comfortable, easy care and safe products. Extensive research work has been done to develop approaches that add desired functionalities and improve aesthetics of cotton textiles. Finishes that provide functionalisation such as wrinkle resistance, flame retardancy, improve colour fastness and dimensional stability, impart soil, water and oil repellency, and reduce mechanical, bio and light degradation are common. However, the benefits provided by these approaches are often limited by their undesirable effects on cotton fibre. Manufacturing, use and recycling of cotton products have also raised some environmental concerns. These concerns led to legislative changes, requiring sustainable, more integrated processes capable of delivering high added-value textile and apparel products.

Additionally, the emerging technologies and continuous progress in new advanced textile materials present strong competition. Increased public awareness and preferences for performance textiles are contributing to the growth of the clothing sectors like outdoor and sports, protective and work wear. For cotton to retain its place in global textile and apparel markets, technological advancement and further innovation in cotton modification and functionalisation methods are needed. Such new approaches would provide critical differentiation of the product, adding desired properties and value.

Anti Microbial

Microorganisms can cause degradation of cotton textiles, discolouration, unpleasant odours and may cause allergies and other health issues. Medical textiles also may require biocidal function.

UV Blocking

Health risks from prolonged sun exposure. Degradation of textiles due to UV radiation.

Flame Retardancy

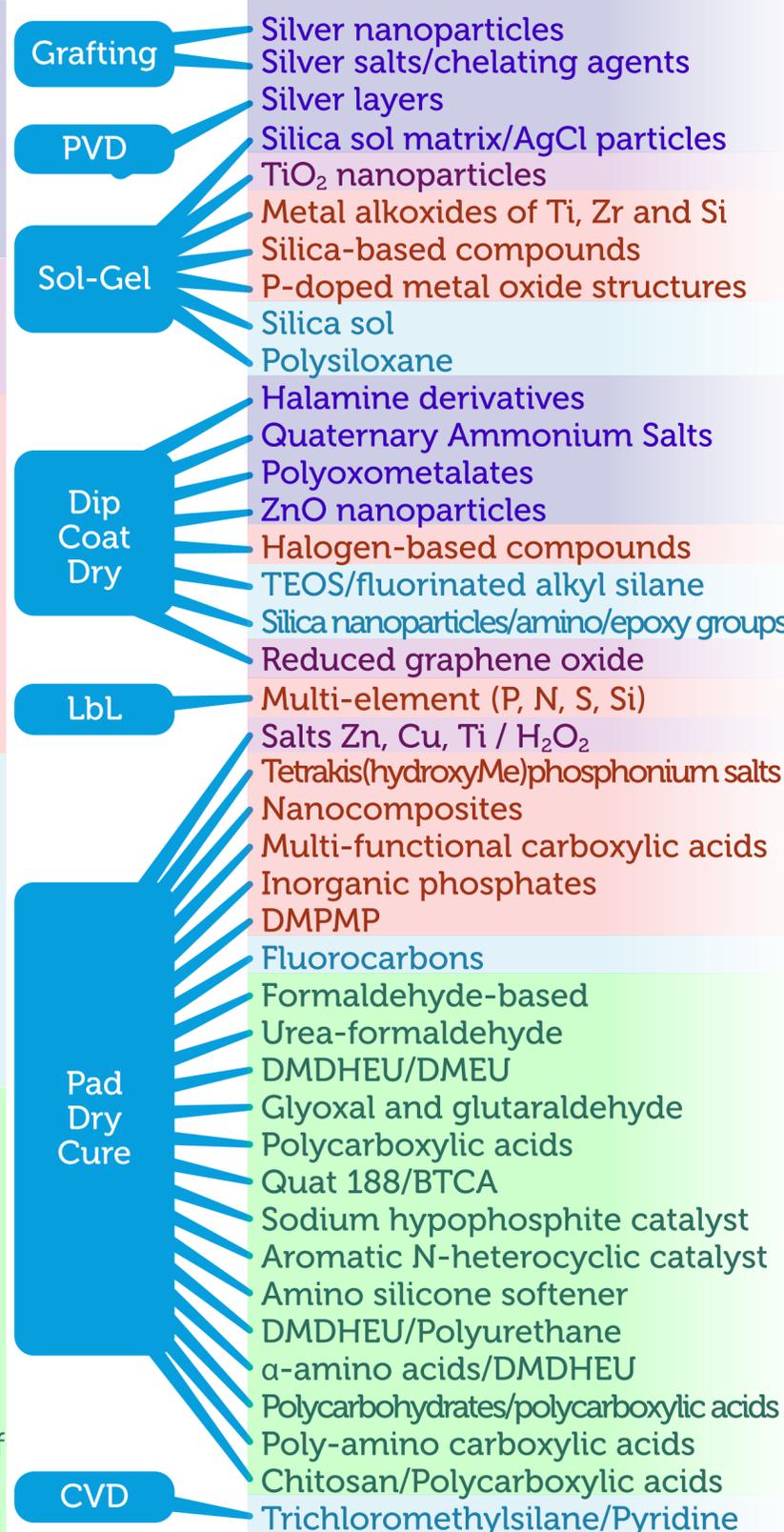
Cellulose is a source of hydrocarbons and easily combusts. Flame retardant fabrics are used as protective clothing for firefighters, military, police, and workwear, and for high performance sports, upholstery and transportation, sleepwear for children and elderly.

Water/Oil Repellency

Repellency of water and other liquids provides self-cleaning function and extend the lifetime of the fabrics due to the prevention of degradation facilitated by damp textile. Oil repellency in industrial or household textiles facilitates cleaning.

Wrinkle Resistance

Cotton fabrics are easily wrinkled during use and care. Absorbed during washing water allows movement of molecular cellulose chains in non-crystalline regions. The hydrogen bonding between re-arranged molecules then fixes the wrinkles in a drying fabric. Cross-linking agents limit the chains movement. However, the finish often causes the loss of flexibility and reduction of tensile strength.



Advantages

- Anti-odour
- Biocidal
- Not inducing microbes resistance
- Slow-release mechanism
- Effect is rechargeable
- Self-cleaning on UV/light exposure
- Durability to laundering
- Durability to abrasion
- ★ Retention of hand and softness
- ★ Retention of strength
- ★ Retention of whiteness
- ★ Thermostability
- ★ Thermo-insulating / char-forming
- ★ Economical
- ★ Potential additional functionality
- ★ Reduction in pollutants

Adverse effects on properties

- ◆ Reduction in hand and softness
- ◆ Low durability to laundering
- ◆ Reduction in fabric strength
- ◆ Yellowing and discolouration

Processing issues

- ◆ Nanoparticles processing issues
- ◆ Cost/Patented process

Environment/health issues

- ◆ Formaldehyde
- ◆ Toxic combustion products
- ◆ Pollution, bio-accumulation