Nanotechnology in textile industry

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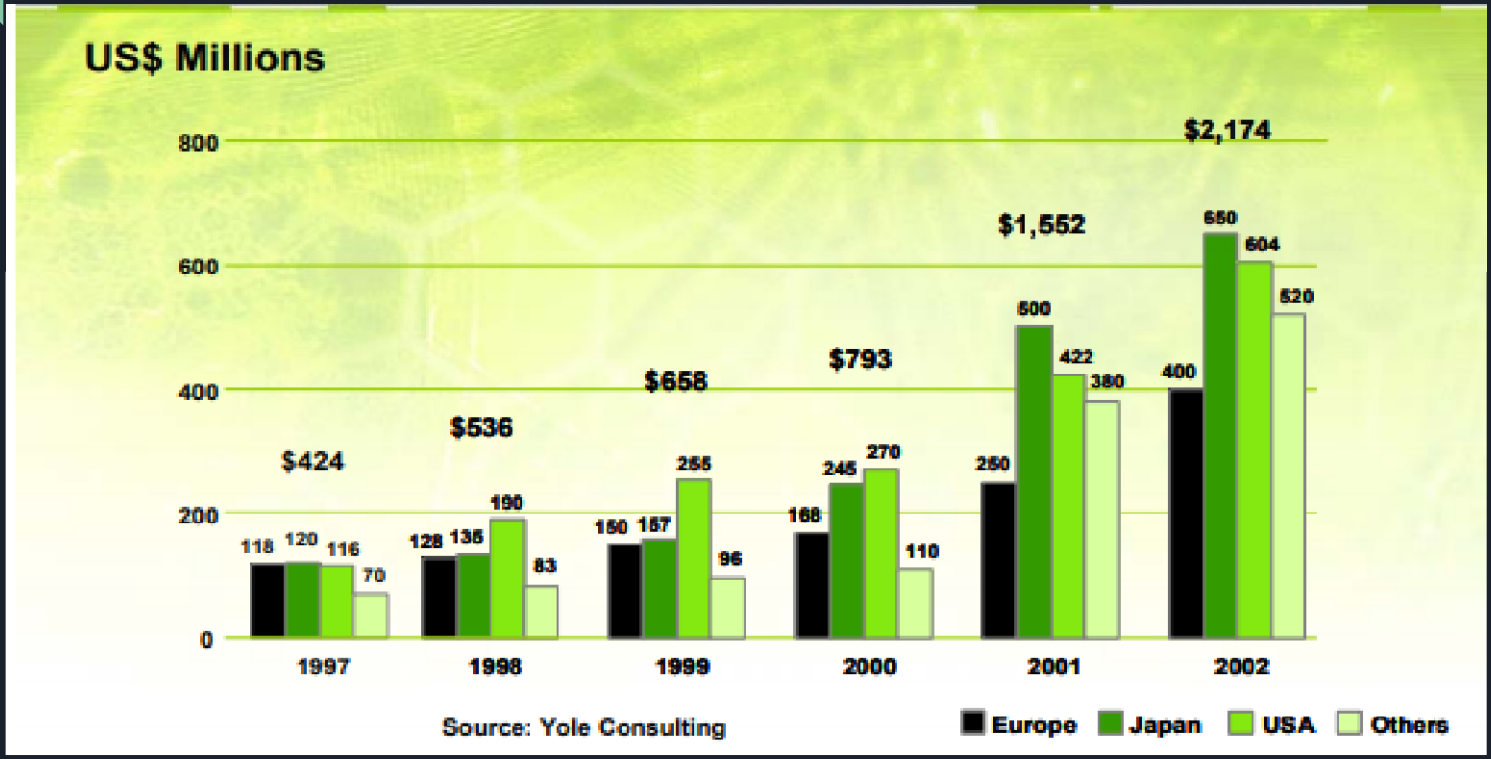
1. Nanotechnology

- ➔ Application of scientific knowledge to manipulate and control matter in the nanoscale.
  - ◆ **Nanoscale:** A nanometer is the millionth part of a millimeter.
    - We get new phenomenons and properties when we manipulate matter at this scale.
      - **Such as:** electrical and thermal conductivity, chemistry reactivity, elasticity and resistance.

Global, public sector spending on nanotechnology



2. Nanotechnology in textile

Advantages:

- ➔ Durability of fabrics
- ➔ Comfortness
- ➔ Hygienic properties
- ➔ Production cost

Properties:

- ➔ Self-cleaning
- ➔ Anti-abrasion
- ➔ Antibacterial
- ➔ Fireproof
- ➔ UV resistant
- ➔ Anti-stain
- ➔ anti-shrinkage

3. Types of nanotextiles

- ➔ 3.1. Nanofinished textiles
- ➔ 3.2. Nanocomposite textiles
- ➔ 3.3. Nanofibrous textiles
- ➔ 3.4. Nano-enabled nonwovens
- ➔ 3.5. Clay nanoparticles
- ➔ 3.6. Carbon nanotubes

3.1. Nanofinished textiles.

- ➔ Post-manufacture treatment.
- ➔ Intermediate steps for coating or treatment.
- ➔ The majority of nanotextile on
- ➔ Additive nanomaterials:
  - ◆ Metal nano-objects.
  - ◆ Clay nano-objects.

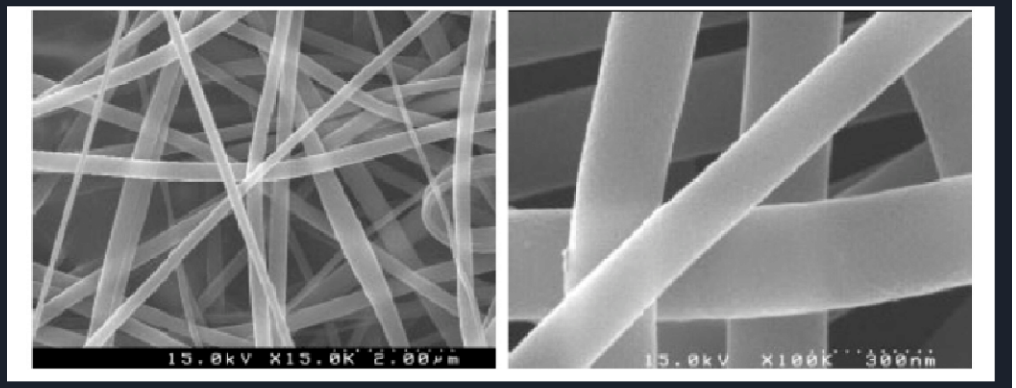
3.2. Nanocomposite textiles

- One or more nanostructured or nanoscale components.
- Pre-manufacture integration .
- Materials added
  - Carbon nanotubes
  - Rare earth metal doped nanoparticles
  - Polymer matrices
- Not require significant changes to the manufacturing process.
- Currently the minority of nanotextile, but that promises in future.

3.3. Nanofibrous textiles

- ➔ Fibres with nanoscale dimensions, which have nanoscale cross section.
- ➔ Nanotextiles focus on fabricating fibres to exploit nanoscale properties.
- ➔ Not only does initial fabrication adaptation, all of the subsequent steps in the manufacturing process must be accommodated.
- ➔ While research into nanofibrous textiles is widespread,

  Commercialization is unusual.



3.4. Nano-enabled nonwovens

- **Nano-enabled:** Features or performance made possible by nanotechnology.
- Improvements in properties to benefit textile processing.
- Nanofilms or coatings in layers or barriers.
- Examples:
  - Antibacterial properties.
  - Energy production.
  - Luminicense.

3.5. Clay nanoparticules

- ➔ Resistant to heat, chemicals and electricity, and have the ability to block UV light.
- ➔ Improve tensile strength, tensile modulus, flexural strength and flexural modulus.
- ➔ Metal oxide nanoparticles used: TiO_2, Al_2O_3, ZnO and MgO

3.6. Carbon nanotubes.

- ➔ Most commonly used.
- ➔ Carbon Nanofibres : effectively increase the tensile strength of composite.
- ➔ Carbon black nanoparticles: improve their abrasion resistance and toughness.
- ➔ Small pore size allows viruses and spore-forming bacterium.

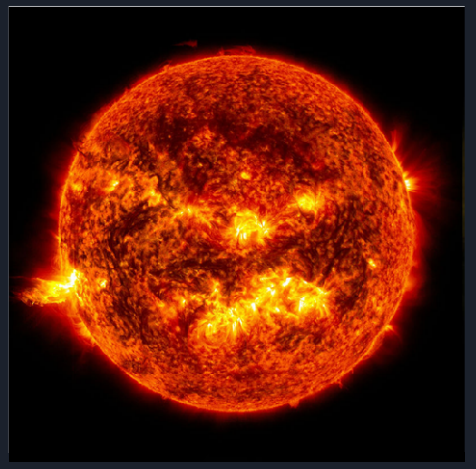
4. Applications

- 4.1. Water repellence
- 4.2. UV protection
- 4.3. Antimicrobial
- 4.4. Antistatic
- 4.5. Wrinkle resistence
- 4.6. Electrical conduction
- 4.7. Flame Retardant

4.1. Water repellence

- ➔ Created by nanowhiskers
- ➔ hydrocarbons 1/1000 of the size of a typical cotton fibre.
- ➔ Liquid can still pass if presure is applied.
- ➔ To improve this property is added hydroxylapatite, TiO_2, ZnO and Fe_7O_3 with other organic
- ➔ Could be modified to achieve abrasion resistance, ultraviolet (UV) resistance, electromagnetic and infrared protection properties.

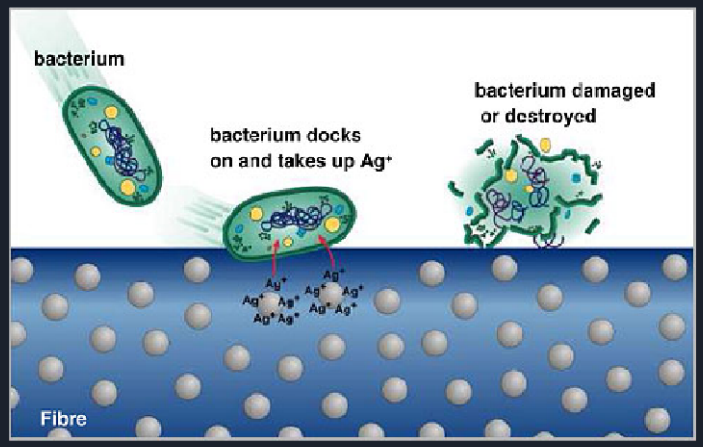
4.2. UV protection



- Inorganic UV blockers
  - Non-chemical
  - Stable under exposure to high temperatures
- TiO_2, ZnO, SiO_2 and Al_2O_3
  - Red one's are used in suncream products.
- It is used sol-gel method
  - Thin layer of nanoparticules is formed on the surface of textile for an excellent UV protection.
- Spraying method

4.3. Antimicrobial

- ➔ Silver, titanium dioxide, zinc oxide, triclosan and chitosan.
- ➔ Nano-silver is very reactive at concentrations as low as 0.0003 to 0.0005%.
- ➔ Bacteria is trapped and it cannot do their vital functions.



4.4. Antistatic

- ➔ Eliminated static electricity generally caused by the triboelectric effect.
- ➔ Titanium dioxide, zinc oxide whiskers, nanoantimonydoped tin oxide (ATO) and silanenanosol.
- ➔ Inconvenience: easily washed off after a few laundry cycles

4.5. Wrinkle resistance

- ➔ Never get dirty or wrinkled
- ➔ nano-titanium dioxide and nanosilica.
  - ◆ Nano-titanium + carboxylic acid
  - ◆ Nanosilica + maleic anhydride -> more wrinkle resistance
- ➔ Attacking fabrics with microwaves to improve this resistance and durability.

4.6. Electrical conduction

- ➔ Allows us to connect sensors to measure cardiac rhythm, breathing, temperature.
- ➔ Conductor polymers that use polypyrrole, polyaniline, polythiophene or carbon nanotubes.
- ➔ Are useful as widgets and functional without losing their properties such as flexibility, appearance etc.

4.7. Flame resistance

- ➔ Resistance of fire in polyester fabrics
- ➔ ZnO concentration (from 0.25 to 0.5 %) decrease inflammability.
  - ◆ Curing between 160-180 °C
  - ◆ A pad-dry-cure method
- ➔ Sodium polyacrylate in an initial pretreatment.
  - ◆ ↑ time ignition and ↓ heat release rate.
- ➔ Then is use octalpropylammonium.
  - ◆ As flame retardant and ↓ of CO_2 and CO production.

5. Conclusion

6. References

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Questions?