Cosmetic Textiles for Hair Care

S. Y. Cheng, C. W. M. Yuen, C. W. Kan*, K. K. L. Cheuk

Institute of Textiles and Clothing, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China

Abstract

Owing to the rapid development of novel sciences and technologies, textile materials have also found applications in the cosmetic field in recent years by working as a basis for cosmetic substances delivery system. In fact, cosmetic textiles can also expand their applications in the field of hair care and treatment. Different hair care functions, like anti-dandruff, anti-alopecia, oil control and colour preserve etc., can be impacted onto the textile that enables an alternative basis for the delivery systems of hair care substances. To achieve these functional finishing effects, microencapsulation technology is an alternative way to provide satisfactory performance with increased durability. Microencapsulation is actually a micropackaging technique that involves the production of microcapsules which act as the barrier walls of solids or liquids. It helps protect each capsule from hazardous environments and allow for the controlled release of active ingredients in a targeted manner to suit specific purposes. With this successful development, it is anticipated that an innovative system integration between hair care and textiles will be established to provide cosmetic textiles with an efficient delivery system of hair care substances. Concurrently, the present study will also lead to a further development in both textiles and hair cosmetic market with novel and user-friendly ideas such as the increase in hygiene and flexibility for hair care and treatment.

Keywords: cosmetic textiles, microencapsulation, hair care

1. Introduction

With the growing vogue in enhancing beauty with health, customers request that the apparels and home textiles not only have the original basic characteristics such as maintaining warmth and providing comfort, but also carry extra functions including environmental protection, anti-pollution and the most concerned function, health and beauty care, in an attempt to provide a more natural and healthier life.

Owing to the rapid development of novel sciences and technologies, textile materials have also found applications in cosmetic field in recent years. A new sector of cosmetic textiles is opened up and the textile industry is very optimistic that these products will open up new target groups and sustainable markets [1].

On contact with the skin and human body, cosmetic textiles are designed to transfer an active substance for cosmetic purposes. One particular example is the transfer of skin-moisturising substances. The principle is achieved by simply imparting the cosmetic and pharmaceutical ingredients into the fabric of clothing so that with the natural movement of body, skin is slowly freshened and revitalised. To achieve the functional effects, microencapsulation technology has appeared to be an alternative way to provide satisfactory performance with increased durability [2].

In view of the increasing demand in the relevant fields, researchers and textile manufacturers have taken a lot of investments in cosmetic textiles for research and product development. At present, the application of aromatherapy in textiles is commonly concentrated on skin caring benefits and stress management. More innovative ideas can be as wide as imagination such as the development in the field of hair care and treatment. The wide range of benefits of hair care benefits and controlled release manner of essential oils is expected to be appreciated by consumers.

2. Microencapsulation technology

2.1 Microencapsulation technology and its advantages

Microencapsulation technology is now rapidly developing in the field of chemical finishing because of its versatility and flexibility. One major advantage of using microencapsulation technology is its ability in protecting active ingredients from hazardous environment, i.e. oxidisation, heat, acidity, alkalinity, moisture or evaporation. Concurrently, it also protects ingredients from interacting with other compounds in the system, which may result in degradation or polymerisation. Another important advantage of this versatile technology is its controlled release properties that seem to be the best choice for increasing the efficiency and minimisation of environmental damage.

Microencapsulation is actually a micropackaging technique that involves the production of microcapsules which act as barrier walls of solids or liquids. The microcapsules are produced by depositing a thin polymer coating on small solid particles or liquid droplets, or on dispersions of solid in liquids. The core contents are released under controlled conditions to suit a specific purpose [1].

Figure 1 shows the general structure of microcapsule which generally consists of two major components:

(1) Active ingredient
Active ingredient is the substance that may be in the form of liquid or solid. It is also referred to the core contents, internal phases, active, encapsulate, payload or fill.

(2) Wall Shell
A polymer coating that surrounds the active ingredients which

may also be called the wall, shell, external phase, membrane or matrix. It may be natural polymer, semi-synthetic polymer and synthetic polymer.

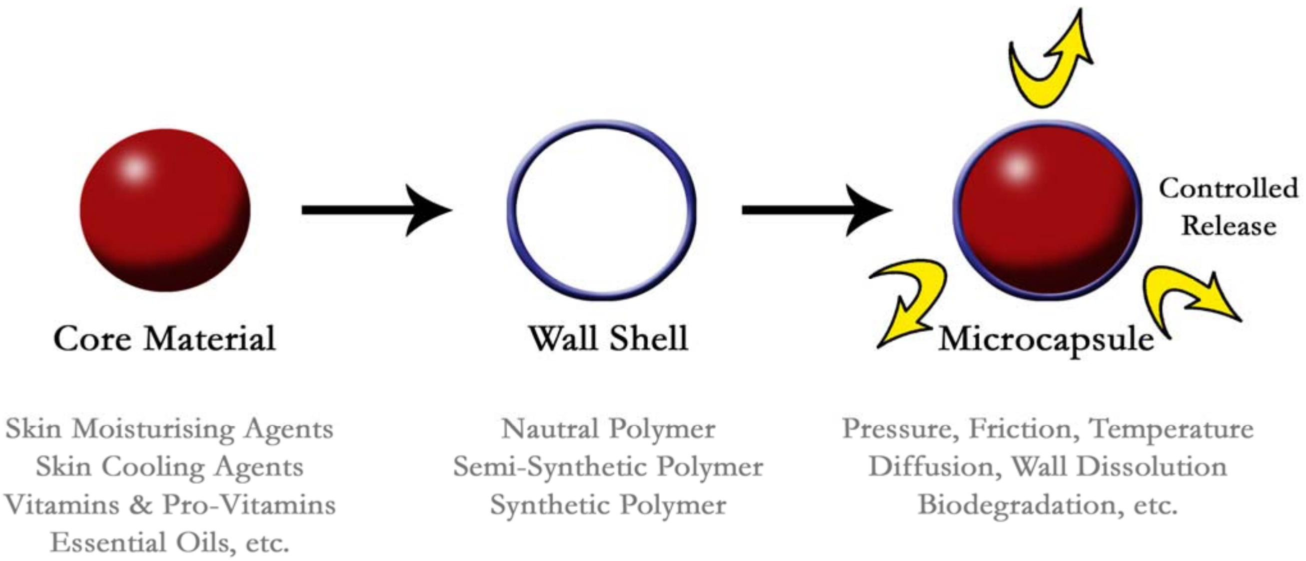

Fig. 1. Structure of microcapsule

The release mechanisms of the core contents vary depending on the selection of wall materials and more importantly, its specific end uses. The core content may be released by friction, pressure, change of temperature, diffusion through the polymer wall, dissolution of the polymer wall coating or by biodegradation, etc.

Many different manufacturing approaches have been adopted for microencapsulation including (1) Complex Coacervation, (2) Polymer-Polymer Incompatibility, (3) Interfacial Polymerisation and In Situ Polymerisation, (4) Spray Drying, (5) Centrifugal extrusion, (6) Air Suspension Coating and (7) Pan Coating.

(1) Complex coacervation

This method take advantages of the ability of cationic and anionic water-soluble polymers to interact in water to form a liquid, polymer-rich phase called a complex coacervation. When the complex coacervate forms, it is in equilibrium with a dilute solution called the supernatant. The supernatant acts as the continuous phase, whereas the complex coacervate acts as the dispersed phase. As the water-insoluble core materials are dispersed in the system, each droplet or particle of dispersed core material is spontaneously coated with a thin film of coacervate. The liquid film is then solidified to make the capsules harvestable. This method has been applied to encapsulate many water-immiscible liquids and is used in a variety of products.

(2) Polymer-polymer incompatibility

Two chemically different polymers dissolved in a common solvent are incompatible and do not mix in solution. The chemicals essential repel each other and form two distinct liquid phases. One phase is rich in polymer designed to act as the capsule shell whilst the other is rich in incompatible polymer. The incompatible polymer is presented in the system to cause formation of two phases. It is not designed to be part of the final capsule shell, although small amounts may remain entrapped in the final capsule as an impurity. The process is normally carried out in organic solvents and is used to encapsulate solids with a finite degree of water solubility.

(3) Interfacial polymerization and in-situ polymerization

In interfacial polymerization, the capsule shell is formed at or on the surface of a droplet or particle by polymerization of reactive monomers. A multifunctional monomer is dissolved in the liquid core material. The resulting solution is dispersed to a desired drop size in an aqueous phase that contains a dispersing agent. The aqueous coreactant, usually a multifunctional amine, is then added to the aqueous phase. A rapid polymerization reaction is then produced at the interface which generates the capsule shell finally. Both liquid and solid can be encapsulated by interfacial polymerization reactions but the polymerization chemistry is typically different.

For in-situ polymerization, capsule shell formation occurs because of polymerization of monomers added to the encapsulation reactor just like interfacial polymerization. However, no reactive agents are added to the core material. Polymerization occurs exclusively in the continuous phase and on continuous phase side of the interface formed by the dispersed core material and continuous phases. Polymerization of reagents located there produces a relatively low molecular weight prepolymer. As this prepolymer grows in size, it deposits onto the surface of the dispersed core material being encapsulated where polymerization with crosslinking continues to occur thereby generating a solid capsule shell.

(4) Spray drying

Spray drying serves as a microencapsulation technique when an active material is dissolved or suspended in a melt or polymer solution and becomes trapped in the dried particle.

In the widely used spray drying process, the dried solid is formed by spraying an aqueous solution of the core material and the film-forming wall materials as fine droplets into hot air. The water then evaporates and the dried solid is separated usually by air-separation. This method has been used to encapsulate labile materials because of the brief contact time in the drier.

(5) Centrifugal extrusion

In centrifugal extrusion processes, liquids are encapsulated by using a rotating extrusion head with concentric nozzles. The fluid core material is pumped through a central tube while liquefied wall material is pumped through a surrounding annular space.

A membrane of wall material is formed across a circular orifice at the end of the nozzle and the core material flows into the membrane, causing the extrusion of a rod of material. Droplets break away from the rod and hardening takes places on passage through a heat exchanger. Solid capsules are removed by filtration or mechanical means, and the immiscible carried fluid, after passing through the files, is reheated and recycled. This process is excellent for forming particles of 400-2000μm in diameter. Since the drops are formed by the breakup of a liquid jet, the process is only suitable for liquid or slurry.

(6) Air suspension coating

In air suspension coating, the particles are coated by dissolved or molten polymers while suspended in an upward-moving air stream. During the process, the solid particles to be encapsulated are first placed in a coating chamber, where they are suspended in an air stream, which causes cyclic flow of the particles past a nozzle at the chamber bottom. The nozzle sprays a liquid coating phase onto the particle. The freshly coated particles are carried away from the nozzle by air stream and up into the coating chamber. The coating solidifies because of solvent evaporation or cooling of a melt. At the top of the spout, the particles settle back to the bottom of the chamber to repeat the cycle. The cycle is repeated many times in a few minutes uintil the coating has been applied in the desired thickness. Air-suspension coating of particles by solutions or melts generally gives better control and flexibility. However, it is commonly used to encapsulate tablets, granules, crystals and powders. It is not used with liquids unless they are absorbed on a porous solid.

(7) Pan coating

This method is widely used in the pharmaceutical industry, which is an traditional industrial procedures for forming small, coated particles or tablets. During the pan coating process, the particles are tumbled in a rotating pan or other device while the coating material is applied slowly at a controlled temerpature profile. Additional coatings of film-forming polymers may be added in successive stages.

2.2 Recent development of cosmetic textiles

As the use of microencapsulation technology offers many opportunities to improve the properties of textiles or enhance them with value-added functions, many textile chemical companies have taken a lot of investigations in this area and offer various microencapsulation treatments aiming at skin caring benefits. Companies working at the forefront in this particular aspect include Cognis, a textile chemical company based in Germany, and another two world leading cosmetic textile finishing companies which are Speciality Textiles Product and Woolmark Development International Ltd (WDI). The microcapsule products contain various benefits such as stress release, skin moisturising, anti-aging, anti-bacterial, anti-fungal and anti-cellulite treatments. The microcapsules will only break through normal wears and release their contents in a controlled manner. It is claimed that the performance can be retained over a long period of time and through multiple domestic laundering.

3. Cosmetic textiles for hair care

It can be seen that the development in cosmetic textiles is commonly concentrated on skin caring benefits and stress management. Indeed, potential development in cosmetic textiles can be as wide as imagination; one typical potential developing area is in the field of hair care and treatment.

Hair plays an important role in self image. It also acts as the physical barriers between us and the environment. However, sometimes, hair damages are ineluctably formed by the environmental stresses and/or chemical treatments such as hair colouration and hair perming. The health of the hair and scalp depend to a great extent on general health and nutrition, and a diet providing a good balance of minerals and vitamins. The market of hair care, in particular, has grown substantially over the past few years. According to the Euromonitor, “Cosmetics and Toiletries in Australia” report, the hair care sector accounts for approximately 24 percentage of the cosmetics and toiletries industry.

Textile materials can then enable an alternative basis for hair care substances delivery systems. Various hair care effects can be delivered to hair through the functional textiles such as dandruff control, herbal treatment, colour preserve and oil control etc. The performance can be achieved by simply imparting the active ingredients onto textile fabric with the integration of aromatherapy and micro-encapsulation technique. Several essential oils are known to beneficial to hair care and treatment. Dandruff can be effectively treated with essential oils like Lavender, Tea Tree, Bergamot or Sandalwood which help to balance the production of sebum. Essential oil of Rosemary is always used in many commercial hair and scalp products and some vegetable oil such as coconut, olive or jojoba oil would also be beneficial to hair conditioning treatment.

With the appropriate selection of essential oils, a wide range of hair care functions can be achieved. The essential oils are to be encapsulated with a protective wall shell which can be slowly released in a controlled manner by cosmetic textiles that provide customers with user-friendly and consistent hair caring benefits. The wide range of benefits of aromatherapy and controlled release of essential oils is expected to be appreciated by consumers.

4. Conclusion

The textiles industry is now going through a revolution aimed at the unique needs of the modern consumer. Cosmetic textiles are increasingly popular and expanding considerably in the textiles industry as the market message becomes more widely appreciated. It is anticipated that the development of cosmetic textiles will continue to grow and expose completely new possibilities for providing bioactive body care functions to wearer in the near future. As a conclusion, the development of cosmetic textiles which provide multi-functional purpose for both hair care and hair treatment is expected to provide a novel and user-friendly delivery system integrated with textiles for hair care and hair treatment aiming to arouse the awareness of the public in hair care aspect. The textile industry must continue to explore and develop functional textiles that fit the capricious consumer behaviour.

Acknowledgements

S.Y. Cheng gratefully acknowledges the studentship provided from the Hong Kong Polytechnic University for this work.

References:

[1] C.W. Kan and C.W.M. Yuen, Cosmetic textiles, Textile Asia, 36(6), pp.29 (2005).
[2] C.W. Kan, C.W.M. Yuen and O.Y.A. Lai, Aromatherapy in textiles, Textile Asia, 36(4), pp.35 (2005).