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Trends in Cosmeceuticals Based Nanotechnology: Up-to-Date

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Authors' contributions

This work was carried out in collaboration among all authors. Authors PS and PHS design and written up the first draft of the manuscript and draw the figures and manage literature searches. Authors MK, DKD and SP was responsible for drafting and critically revised the manuscript. Authors NS and AKS participated in technical check and revision of manuscript for final approval. All authors read and approved the final manuscript.

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ABSTRACT

The American physicist Richard Phillips Fenyman, first proposed the concept of nanotechnology in the year 1959. However, the researcher and professor (Tokyo University of Sciences) who actually coined the term 'nanotechnology' was Norio Taniguchi, in 1974. Now, to improve the efficacy of cosmetic and therapeutic applications in this field, the cosmetic industry is significantly embracing nanotechnology. The application of nanotechnology in the field of cosmeceuticals makes cosmetics very effective, providing better protection against UV rays, deeper penetration into the skin, long-lasting effects, higher colour, quality of finish and more. This review critically collects the latest updates regarding the use of nanomaterials for the preparation of cosmetics for pharmaceutical applications. In addition, this review provides a brief overview of almost all nano forms as cosmetic formulations different types, of cosmetics based on nanotechnology and patents.

Keywords: Nanotechnology; cosmetics; cosmeceutical; patents; skin care; nanocosmetics.

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1. INTRODUCTION

Nanotechnology is a science which deals with particles having size range 1 to 100nm [1]. It is multidisciplinary science used among all field's; physics, chemistry and biology. Nanotechnologies convert material or particle into very small size where they gain some new properties as compared to larger forms. The developed formulations and/or forms are used in cosmetics and health care. This improves efficiency of drugs as it avoids problems like drug insolubility, chemical and physical decomposition, etc. [2]. Now a days, this technology is widely used in cosmetics. The effect of cosmetic product relies on composition of ingredient and on areas where they needed reached or not. According to Food and Drug Administration (FDA), cosmetic is defined as "product intended to apply on skin or body surface for cleansing, beautifying, promoting attractiveness, or altering the appearance." Cosmeceutical is fastest growing section of the selfcare industry, and number of topical cosmeceutical treatments for conditions such as photoaging, sunburn, wrinkles, hair damage, etc. have come into wide spread use. Global market of cosmeceutical increasing by 7.7%. Nanotechnology in cosmeceutical gives the advantage of diversity of products, increase in bioavailability of active ingredient. Cosmeceutical industry use nanotechnology to improve their products for better skin penetration, UV protection, quality and colour, long term effects, etc. [3].

Innovations in cosmetics by nanotechnology are liposome formulations which contain small vesicles consisting of conventional cosmetic materials that protect oxygen or light sensitive cosmetic ingredients; nanoemulsions, that are transparent and have unique tactile and texture properties; nanocapsules, used in skin care products; nanopigments, transparent formulation which increases the efficiency of sunscreen products. Others are niosomes, nanocrystals, solid lipid nanoparticles, carbon nanotubes, fullerenes, and dendrimers. Nanodrugs/nanomaterial allow controlled release of active ingredient by regulating drug release from carriers based on variety of factors such as physical or chemical interactions among the components, drug composition, polymer and additive composition, ratio, and manufacturing process [3,4]. It has a longer duration drug release time, better skin penetration, and higher stability, as well as site-specific targeting. The high entrapment efficiency improves the texture of cosmetic products, increase absorption rates, increase product solubility, and extends the shelf life of cosmetics [4]. Other advantages of using nanoparticles in cosmeceuticals are stability improvement of cosmetic ingredients such as vitamins, unsaturated fatty acids, and antioxidants by encapsulating inside the nanoparticles; artistically attractive products include mineral sunscreens made up of smaller particles of active minerals allows them to be applied lacking a noticeable white cast; an efficient protection of the skin from harmful ultraviolet (UV) rays; targeted delivery of active ingredient to the desired site and control the release thereof for prolonged effect [5]. Some restrictions over using nanoparticles are; penetration of unwanted nanoparticles through the skin and systemic circulation. In particular zinc oxide and titanium dioxide nanoparticles ranging from 10 to 200 nm in the sunscreen products can penetrate the intact skin and impose inadvertent biological damage. Nanoparticles may cause environmental issues if exposed to water air and soil. Because of high reactivity, it may alter the biological properties and exploited in various application because of its unique features [6].

2. NANOMATERIALS USED IN COSMECEUTICALS

2.1 Liposomes

Liposomes ranges between 20 nm to some hundred micrometres. Liposomes are concentric bilayer vesicles in which the watery volume is totally encased by lipid bilayer made out of regular or manufactured phospholipid which are GRAS (generally regarded as safe product). The lipid bilayer of liposomes can combine with other bilayers like the cell layer, which advances arrival of its substance, making them helpful for restorative conveyance application [1,3,7]. Their ease of preparation, improved assimilation of active substance by skin and continuous delivery of agents into the cell over a supported period of time make them acceptable for cosmetic use. Vesicles other than liposomes are being utilized these days that claim to advances improve the entrance of substance over the skin, such as transferosomes, niosomes and ethosomes [1, 8]. Liposomes are utilized in various cosmetics since they are biocompatible, biodegradable, nontoxic and adaptable vesicles and can encapsulate

active ingredient easily. One of the most fixing ingredients is phosphatidylcholine which has been utilized in skin care item (moisturizer, lotion, cream, etc.) and hair care items (shampoo, conditioner) due to its softening and conditioning properties. A few active ingredients such as vitamins A, E and K etc. and cancer preventive agent like carotenoid, lycopene, CoQ10 etc. have been incorporated into liposomes which leads to increment of physical and chemical stability when dispersed in water [3,4].

2.2 Niosomes

Niosomes are non-ionic surfactant vesicles that are made by using non-ionic surfactant. As compare to liposomes, these vesicles have a higher entrapment efficiency, superior chemical stability, and increased penetration as well as lower production cost [8]. A niosomes is nanostructured with a dimension ranging from 100nm to 2μm in diameter, containing an aqueous cavity at its core surrounded by layers of proteins. In the lamellar phase, there is non-ionic surfactant. They have ability to encapsulate both lipophilic and hydrophilic compounds, making them similar to liposome in terms of cosmeceutical uses. Topically they have been tested as vesicular carriers for a variety of medications and cosmetic [3,9]. Niosomes have been discovered to be effective in topical administration of active substance because they can increase the active ingredient residence time in the stratum corneum as epidermis, as well as lowering system absorption. Targeted delivery is possible with the use of niosomes because the active ingredient is delivered directly to the site where the therapeutic effect is desired. Along with niosomes, proniosome are utilized in order to get improved drug delivery vehicles. The moisturizers and skin lightening creams, anti-wrinkle creams, shampoos and conditioners have additionally been formulated through niosomes [10].

2.3 Nanocrystals

Nanocrystals, an atom aggregates, made up of hundreds to thousands of atoms that come together to form a “cluster”. These aggregates are typically between 10nm to 400nm in size, with physical and chemical properties that fall halfway between bulk solids and molecules. They allow for safe and efficient skin passage [1]. Controlling their size and surface area allows them to adjust their distinctive qualities, such as bond gap, charge conductivity, crystalline structure, and melting temperature. After dispersion these nanocrystals in water, they can readily be transformed into topical formulation i.e., nanosuspensions [2]. The first nanocrystal-based skin renewal marketed product Juvedical with rutin (flavonoid) as the active component was launched by Juvena [3]. La prairie is another hesperidin product that contains nanocrystal. Lancome, a French cosmetic business, has launched Renergie micro lift, a nanocrystal-based anti-wrinkle lotion [11]. As evaluated by antioxidant action, nanocrystals are dermally more available and make the cusp more accessible.

2.4 Inorganic Nanoparticles

Metals or metal oxide NPs are considered as inorganic nanoparticles. Such nano forms behave differently from organic polymeric NPs. In which nano silver increased antibacterial capabilities are being used by cosmetic companies in a variety of applications. Some companies are already selling underarm deodorants that promise to provide up to 24 hours antibacterial protection due to silver content [6]. Gold nanoparticles, like nano silver, is said to be very good at killing bacteria in the mouth and has also been studied [1]. The gold core of gold nanoparticles is inert and nontoxic [12]. Because of high antibacterial and antifungal capabilities, it is also used in face packs, antiaging creams, ointment etc [3]. Other form such as titanium oxide NPs, zinc oxide NPs, silica NPs, aluminium oxide NPs are widely used in cosmetic industries due their marked applications in skincare products. Apart from these, several nano forms of carbon such as fullerenes, nanodiamonds and nanotubes have remarkably applied in skin care and haircare products [6].

2.5 Nano Capsules

Nano capsules are sub microscopic particles that have an aqueous or oily core and are enclosed in polymeric capsule [13]. When compared to conventional emulsion, the introduction of nano capsules reduces UV filtered octyl methoxycinnamate penetration in pig skin [1]. It is encapsulation based and can carry drug payloads for local action and/or targeted drug delivery. These are used in cosmetic to protect important active ingredients from being harmed by an oily or watery state. Nano capsules in the form of polymeric suspension can be applied to the skin

and are used to encapsulate various components [13]. The type of polymer and surfactants employed can also be used to change the properties of nano capsules. By nano precipitating poly l-lactic acid, stable forms of nano capsules with diameters of 115nm can be obtained [3]. The aromatic molecules have been encapsulated in these nano capsules, resulting in a continual release of perfume. As a result, these Nano capsules are biocompatible and can be found in a variety of deodorants. Proteins, polymers, and biomolecules can be bonded to nano capsules surfaces. These nano capsules are biodegradable and biocompatible in nature, and they are stable in aqueous media. Particle dimensions are influenced by the polymer attached to nano capsules. these particles are biocompatible and disintegrate into CO_2 and water when exposed to sunlight. The body is capable of excreting these compounds. The antioxidant components in antiaging cosmetic formulas are carried via nano capsules [14,3]. Different varieties of nano capsules are formulated depending on the nature of the item to be incorporated. Companies like Exlica ltd. and Micapt are exploring various materials to be utilized as nano capsule shells, for example polymer microbeads, silica nanoshells, microbial cell wall etc. [11].

2.6 Solid Lipid Nanoparticles (SLNs)

Solid lipid nanoparticles are submicron colloidal carriers made up of physiological lipid dispersed in water or aqueous surfactant solution with a size ranging from 50 to 1000nm. They are oily lipid droplets that solidify at body temperature and are stabilised by surfactant. They can safeguard the encapsulated components, which are used in process from deterioration [15]. SLNs are popular in cosmeceuticals for many reasons: they are made up of physiological and biodegradable lipid with low toxicity. SLNs have occlusive characteristics that help to keep the skin hydrated [11]. Cosmetic agent is delivered in a controlled manner over a longer period of time. It has been discovered to increase the penetration of active ingredients or compounds which are deposited in the stratum corneum [1]. The hydrophobic structure of the SLNs allow them to protect the skin from drying while also maintaining its moisture content [4].

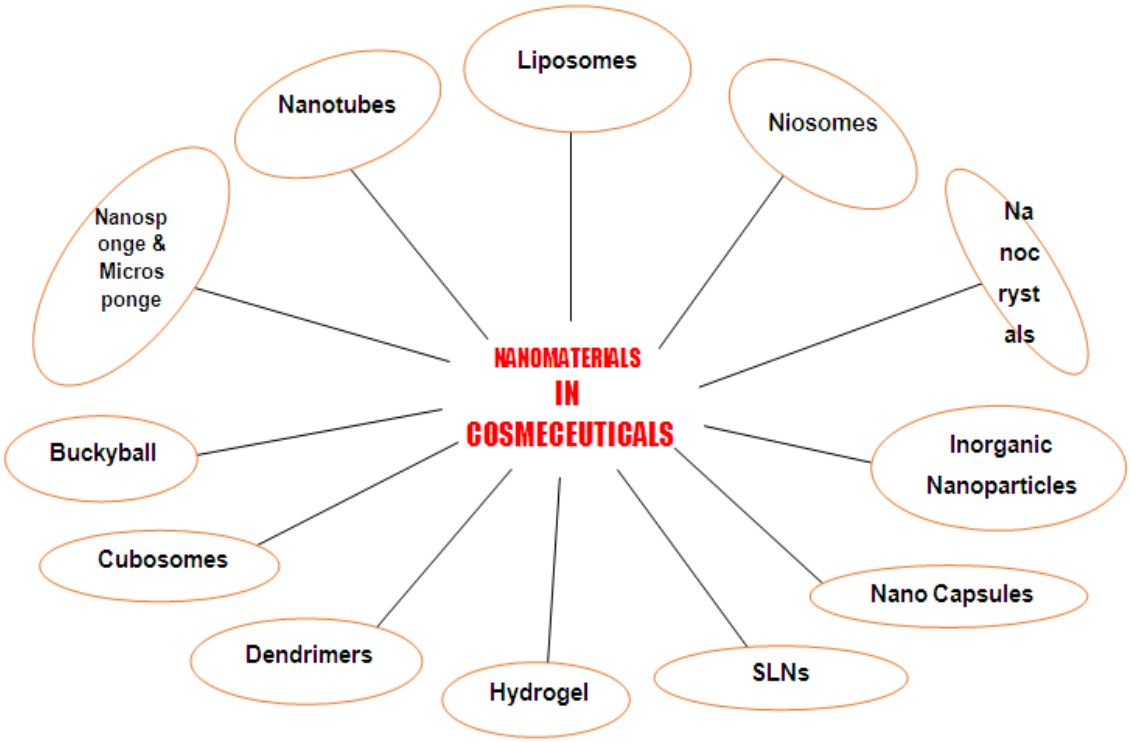

Fig. 1. Types of nanomaterials used in cosmeceuticals

2.7 Hydrogel

Hydrogel, a 3D structured hydrophilic polymer network that swells without dissolving in water or biological fluids due to chemical or physical cross-links. High water absorption capacity is due to the presence of hydrophilic functional groups in polymer structure such as amide Hydroxyl and sulphate [16]. Hydrogels are primarily used topically in cosmetic applications such as on hair, skin and nails. The use of bioadhesive hydrogels for skincare purpose has several advantages, including long residence time on the application site and reduced product administration frequency. So far, several cosmetic formulations containing active cosmetic ingredients have been developed as hydrogels [16]. Hydrogel used in cosmetic preparation can be made from various biopolymers, including collagen gelatine, hyaluronic acid, alginate, chitosan, xanthan gum, pectin, starch, cellulose and derivatives [5]. Biopolymer based hydrogels are used in the development of new cosmetic products such as "beauty mask". These masks are said to hydrate skin, restore elasticity, improve anti-aging performance. Superabsorbent hydrogels, particularly acrylate-based materials, are widely used to absorb fluids in hygiene products because they can keep moisture away from the skin, promoting skin health, preventing diaper rash, and providing comfort [16]. There are many types of hydrogels that exist Physical and chemical hydrogel, Conventional and stimuli-responsive hydrogel, Thermosensitive hydrogel, Photo responsive hydrogels, and pH, electric and magnetic responsive hydrogels [17].

2.8 Dendrimers

Dendrimers are unimolecular, monodisperse, micellar nanostructures with a well-defined, regularly branched symmetrical structure and a high density of functional end groups at their periphery, measuring about 20nm in size. This gives an advantage in case thin film required for e.g., nail enamel, mascara, etc. They have a large number of external groups that lend themselves well to provide multifunctionalities [1]. The formation of dendrimers is determined by the presence of a total number of series of branches. There is only one series of branches in the first-generation dendrimer; there are two series of branches in the second generation. These are employed as vehicles for delivering active substances to the desired location in a slow and regulated manner. The particles are symmetrical and have various functional groups. Dendrimer surfaces can serve as carrier for numerous external functional groups [3]. Biodegradable polymers, such as polysaccharides, polyesters, polyalkylcyano crylates, and polyamidoamine (PAMAM) dendrimers, have been shown to be effective encapsulating agents in cosmetic and personal care formulations [18,19]. Dendrimers are incorporated in the formulation of many cosmetics. L'Oreal owns a patent on the use of dendrimers in cosmetics like mascara and nail polish [20].

2.9 Cubosomes

A bi-continuous cubic liquid crystalline compound with discrete and sub-micron size nanoformulations, called as Cubosomes. However, they are self- assembled liquid crystalline particles with a solid like rheology that have unique features of practical significance [20] wherein lipophilic, amphiphilic, and water-soluble cosmetic compound can be incorporated. For cosmetic formulations, this system may be used as challenging techniques [21]. Cubosomes are ranges from 10 to 500nm [19]. It is made up of liquid crystalline particles of certain surfactants that get self-assembled when mixed with water and a microstructure in a specific ratio. They have a huge surface area, low viscosity, and may exist at nearly any dilution level. They are heat resistant and can transport both hydrophilic and hydrophobic chemicals. they are an appealing choice for cosmetic because of the low cost of the basic components and ability for regulated release through functionalization. As well as for the delivery of drugs [1]. Cubosomes have been patented for usage in pharmaceutical and personal care product as active delivery vehicles, emulsion stabilisers, and pollution scavengers [22]. A common application for such novel material is as drug delivery vehicle. Cubosomes particles are being studied in collaboration with cosmetic business such as L'Oréal and NIVEA to see if they can be used as oil in water emulsion stabilisers and pollutant absorbent in cosmetics [20]. Researchers in cosmetic science have been drawn to cubosomes because of their ability to solve problems associated with dermal delivery system. Researcher attempted to entrap a

hydroxypropyl-cyclodextrin (HPCD)- minidoxil (MXD) complex using glycerol monooleate (GMO) based Cubosomes. MXD-loaded Cubosomes had higher in vitro skin penetration than MXD in a propylene-glycol-water- ethanol solution [19].

2.10 Nanotubes

Nanotubes are nanomaterials from carbon nanoparticles. They are naturally occurring (halloysite clay nanotube (HNT)) tubular shape nano forms promising for hair treatment. Carbon nanotubes (CNTs) are hollow cylindrical fibbers made up of graphene walls. They are rolled, hollow cylindrical graphene threads. CNTs are extremely light in weight, with diameter ranging from 0.7 to 50nm and lengths of about 10 microns [23]. Hair colouring agents has been demonstrated with carbon nanoparticles, notably graphene-based nanomaterials. Despite of many applications, they are unsafe for human health care. Colour nano formulations are created by combining different biopolymers such as chitosan and graphene. This formulation is heat dissipative and has a strong resilience to various shampoos [24]. Simple coating method, such as dipping in CNT-dispersions, resulted in a black colour on both bleached and non-bleached grey hair. Peptide based CNT colourants, produced diblock composition and improved hair affinity through covalent conjugation when a hair-binding peptide was coupled to the nanotube surface. Carbon nanotubes' hair related multiple application led to the invention of CNT-based artificial fibre sensors [25,26].

2.11 Buckyball

Buckyballs, also known as Buckminster fullerene, are built up of odd-numbered carbon atoms organised in rings to resemble the structure of some footballs, but its diameter is measured in nanometres. They are antioxidants that absorb the radical oxygen and have smoothing qualities in moisturisers, promoting skin renewal for a long time [27]. Their excessive hydrophobicity had discouraged their utilisation, although surfactants had helped to overcome. The Zelens fullerene C_{60} night cream, an anti-aging cosmeceutical with outstanding antioxidant capabilities, is one commercial product that contains buckyball [24,28].

2.12 Nanosponges and Microsponges

Nanosponges are tiny-mesh structures that contains a wide range of substances. They have demonstrated as a spherical colloidal in nature [29]. Microsponge delivery system compromising of porous microsphere that may entrap a wide spectrum of actives and then release them into the skin over time and response to trigger. The diameter ranges from 10 to 25 microns. Microsponge systems are made up of microscopic polymer-based microspheres that can suspend or entrap a wide range of components before being mixed into manufactured product like a gel, cream, liquid or a powder [30]. The original purpose of nanosponge and microsponge was to transport medication to the skin. They are colloidal carriers that have recently been created and proposed for drug administration due to their capacity to solubilize poorly water soluble medicines and gives sustained release, as well as enhancing drug bioavailability and in certain cases, changing pharmacokinetic characteristics [31]. Nano sponges have high entrapment capacity and release active ingredients in a diffusion-controlled way. Their properties have made them popular in dermatological and cosmetic product. Antifungal, local anaesthetic, antibiotic, and other topical medication can be loaded onto nanosponges. These sponges can then be mixed with a base, such as gel, lotion, cream, powder or ointment, and applied topically [32].

3. SOME EXAMPLES OF NANO-TECHNOLOGY BASED COSMETIC PRODUCTS

3.1 Skin Care

The skin care composition usually consists of antioxidants, vitamins, or proteins that are featured with anti-ageing properties. For this motive and to enhance bioavailability, nano carriers are usually used [33]. The products that are utilised on the epidermis are known as cosmetic products. The effectiveness of skin care product can determine by the substances used and technology utilised to prepare them. A cosmetic product is made up of an active component and other substances that comprise the product's base, "vehicle", or presentation, such as creams, lotions, and gels [6].

Nanoparticles have been successfully used to change the colour of skin. This method employs blending technique having nano particle-based composition to establish natural skin colour first, followed by the desired skin colour. For example, silver nanoparticles with a blue coloration are used to set initial skin colour, followed by gold nano particles with a green coloration, resulting in a brighter tone. Nanoparticles have been selected on the basis on the skin type and colour [34].

3.1.1 Sun Screen

Sunscreens are UVR-absorbing, UVR-scattering, or UVR-blocking agents. Physical sunscreen works by reflecting or scattering UVRs, preventing electron beams from reaching the skin's surface. They are also known as sunblock's [35]. Now a days nano sized components are found in many modern cosmetics and sunscreens. Insoluble titanium dioxide (TiO_2) or zinc oxide (ZnO) nanoparticles are used in recent sunscreens because they are colourless and scatter UV more effectively than bigger particles [36]. When titanium dioxide NPs are coated and evenly distributed as in non-agglomerated coated nanoscale materials, the optimum UV attenuation occurs. This suggests that titanium dioxide NPs may be more effective while providing minimal health risks [37]. Companies like VLLC, Sunjin Chemical Co. Ltd. manufactured nanoshells, metal oxide nano for sunscreen, nano-sized particle employed surface coting joined together silica beads. These elements combine to provide wide range of nano sized titanium dioxide particle used in cosmetic sun screen [28].

3.1.2 Antiaging Cream

Antiaging products are one of nano technology tools in cosmetic inventory. Nano based antiaging preparations rely heavily on retinoids. Retinoids are vitamin A derivatives that are used to treat variety of dermatological conditions including photoaging, acne psoriasis [38]. PAMAM dendrimers enhance resveratrol's solubility and stability in aqueous and semisolid dose preparation. As a result, this product would be a water based 'green' formulation that is free of toxic organic solvents and oils and applied on skin, which was developed by Tyler Pentek et al. [39].

3.1.3 Moisturizer

Moisturizers are complex composition of chemical agents that attract water and reduce evaporation to keep skin exterior layer moist and supple. As a result, these cosmetics are designed to prevent trans epidermal water loss and to maintain or raise the water content of the subcutaneous layer [40]. In recent studies safranal loaded solid lipid nanoparticles have moisturizing properties. SLNs is used because it has high permeability property and increases water content [41].

3.2 Hair Care

Nano material can be used in hair cosmetics to maintain the shine, silkiness and health of hair. This includes shampoo, conditioner, hair dye etc. [42]. Gold, silver and copper nanoparticles are used in hair care products [43]. In global hair industry nanoparticle based hair product is emerging high to provide better texture and nutrition to hair follicles. One silicone based nano formulation is developed for hair treatment without destroying the follicles and it diffuse to hair fibres [44].

3.2.1 Shampoo

Silver nanoparticles are used in anti-dandruff shampoo as they have anti-fungal properties [45]. Silver nanoparticles manufactured by green synthesis methodology, act more efficiently against *Malassezia furfur* (dandruff causing fungus) than any other normal anti-dandruff shampoo, developed by santanu paria et al [46]. RBC Life Sciences, Inc. NanoCeuticals™ developed NanoClusters™, a nanosize powder to make citrusmint, shampoo and conditioner to give healthy hair with shine [47].

Apart from all such industrial products, there are many formulations available into market as listed below (Table 1) which has a higher potential in cosmeceuticals.

4. LIST OF SOME PATENTS OF NANOCOSMECEUTICALS

Various patents related to nanocosmeceuticals are listed in Table 2.

Table 1. List of some commercially available products formulated as Nanocosmeceuticals

Nanomaterials Used	Marketed Product	Manufacturer/Inventor
Nano complexes	BIONOVA nano skin tech range	Baymes New York®
Fullerene	Dety: age management exfoliator	Bellapelle™ skin studio
Niosomes	Revitalift intense lift treatment mask	L'Oréal Paris USA
Nanoemulsion	Soleil aqua nano emulsion	Hair style international
Nanocapsules	Hydra fresh bonzer	Lancôme
Zinc oxide NPs	Nano in foot moisturizing serum	Nano infinity nano tech Co ltd.
Silver NPs	Nanover™ mask pack	GNS nanogist
TiO_2 NPs	Eucerin Sun Lotion for Dry Skin SPF 50+	Beiersdorf AG
Liposomes encapsulating a blend of antioxidants	Resveraderm ANTIOX	Sesderma
Liposomes encapsulating Vitamin C and Gingko Biloba extracts	C-Vit Liposomal Serum	Sesderma
ZnO and TiO_2 NPs	Daylong	Galderma
Niosomes containing cannabidiol	Niosome Day Cream	Blossom
Retinol-loaded Lipodisq	Dragon's Blood Hyaluronic Night Cream	Rodial
SLNs	Allure Body Cream	Chanel
Coenzyme Q10-loaded NCLs	Cream Nanorepair Q10	Dr. Rimpler GmbH
Nanospheres containing Dimethylsilanol Hyaluronate	Filler Intense Cream	Cellact
Gold NPs	24K Nano Ultra Silk Serum	Orogold Cosmetics
Gold NPs	Nano Gold Energizing Eye Serum	Chantecaille
Silver NPs	Micro Silk White Lotus Intensive Lotion Mask	Joyona

Table 2. List of some Patents

Patent/Publication Number	Title of Patent	Publication Year	Reference
EP3597594A1	Graphene product and cosmetic uses thereof	2020	[48]
RU2714489C1	Method of producing nano capsules of nettle dry extract	2020	[49]
GR20170100423A	PET shampoo with integral nanoparticles	2019	[50]
BR102018004126A2	Cosmetic preparation with hydrating, antioxidating, and photoprotective action containing extracts of the species *Spondia purpurea,* whether or not vehicle on lipid and polymeric nanoparticle.	2019	[51]
KR20190079276A	Antiaging cosmetics with nanoparticles-ingredient that solubilized insoluble oligoanionic acid and manufacturing method for antiaging cosmetics	2019	[52]
CN108514634A	Navel plaster	2018	[53]

CN108401417A	Cosmetics Containing Nanoparticles Having Encapsulated Therein Whitening-Improving Active Ingredient, and Method for Producing Said Cosmetics	2018	[54]
US201800008521A1	Low viscous cosmetic composition using natural emulsifying agent	2018	[55]
WO2018105755A1	Cosmetics containing nanoparticles having encapsulated therein whitening-improving active ingredient, and method for producing said cosmetics	2018	[56]
BR102015012999A2	Composition, process of preparation, and use of nano cosmetic based on carnauba wax and quercetin with moisturizing, antioxidant and photoreactive action	2018	[57
KR20170093387A	Skin care composition containing stabilized natural extract with nanosomes	2017	[58]
US20170281735A1	Compositions and methods for treatment of photoaging and other conditions	2017	[59]
ES2602107T3	Nano emulsion	2017	[60]
BR102015032464A2	Topical formulation for photoprotection containing Passiflora Cincinnati	2017	[61
CN105662974A	Preparation with skin light aging prevention function and application of preparation	2016	[62]
CN104606125A	Plant nano-emulsion anti-freckle cosmetic cream	2015	[63]
CN105012202A	Nutritional hair blackening puff cake for beautifying baldness	2015	[64]
US20150223451A1	Nano formulation of musk-derived bioactive ingredients for nano cosmetics applications	2015	[65]
KR20130058477A	Cosmetic composition using chlorella and natural sulfur by nanotechnology a method for preparing the same and a cosmetic material prepared by a method	2013	[66]
EP2852371A2	Cosmetic compositions comprising magnetosomes and uses thereof	2013	[67]
CN103263371A	Skin care product comprising nano tamanu oil emulsion	2013	[68]
RU2499406C1	Composition for producing cosmetic products and method for production thereof	2013	[69]
US20130022655A1	Metal oxide nanocomposites for UV protection	2013	[70]
US20130068242A1	Semipermanent mascara and method of applying	2013	[71]
CN101966130A	Silybin nano crystal cosmetics and preparation method there of	2011	[72]
CN101747536A	Nano chitin. Derivative thereof and daily cosmetic application	2010	[73]
CN1813657A	Application method of nano calcium phosphate like salt for cosmetic product	2006	[74]

5. CONCLUSION

From last two decades nanotechnology has made its inevitable space in almost all fields. It has also brought revolution in several industries. Amongst all the cosmeceutical industries have made a tremendous growth. Day by day they are manufacturing many cosmetic products with pharmaceutical application by using nanotechnology. Various forms of nanomaterial

they have used to spread and for commercialization of nanotechnology in cosmeceuticals and given rise to technical and economic aspirants. Innovation, now a days an indubitably the driving force of rapid changes in the marketplace, causing the development of ever-new solutions to unresolved issues. In the correspondence, the use of such nano material in the field of cosmeceuticals is providing a renewed spur to conventional research approaches. Invention of novel delivery systems such as liposomes, niosomes, SLNs, NLCs, cubosomes and other nanomaterials like fullerenes, AuNPs, AgNPs, has risen up the use of nanotechnology in cosmeceuticals. With the packet of boon, this technology also comes up with some risks for the humans and environment. Even so, further studies are needed to understand the toxic effects of nanomaterials as the side-effect-free character of cosmetic products is a significant aspect.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

It's not applicable.

ETHICAL APPROVAL

It's not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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