

ORIGINAL ARTICLE

# Micro and nanocrystalline diamond skin care products and their applications

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## ABSTRACT

A diamond is transparent crystal of tetrahedrally bonded carbon atoms in a covalent network lattice (sp<sup>3</sup>) that crystallizes into the diamond lattice which is a variation of the face centered cubic structure. Diamonds have been adapted for many uses because of the material's exceptional physical characteristics. Diamonds are naturally lipophilic and hydrophobic, which means the diamonds' surface cannot be wet by water but can be easily wet and stuck by oil. This property can be utilized to extract diamonds using oil when making synthetic diamonds. However, when diamond surfaces are chemically modified with certain ions, they are expected to become so hydrophilic that they can stabilize multiple layers of water ice at human body temperature. **Diamonds**, the most precious gemstones, have been widely recognized for their exceptional powers and miraculous therapeutic abilities. This review attempts to guide the reader between the various micro and nanocrystalline diamond skin care products and their applications, with a particular focus on Diamond Cellular Anti-Ageing Cream. Paper also deals with Scanning Electron Microscope (SEM) images, Transmission Electron Microscope (TEM) images and FTIR spectra of Diamond Cellular Anti-Ageing Cream. This research, along with better regulation and reporting, will enable consumers to choose products with confidence. This in turn will allow companies to benefit from these novel technologies in the long term while retaining customer confidence. Diamond Cellular Anti-Ageing Cream combines advanced technology with luxurious ingredients to target all the effects of ageing for younger looking skin. It provides all the skin's needs in one product. With this skin appears younger, firmer and brighter, wrinkles and the fine lines appear plumped out, facial contours look redefined. This exceptional beauty treatment contains a Diamond Elixir and an Eternal Beauty Complex that work together to fight against the visible signs of ageing for a younger looking skin. Morphological graphs of the Diamond Cellular Anti-Ageing Cream samples are provided by scanning electron microscopy (Digital Scanning Electron Microscope - JSM 6100 - JEOL) with a Link analytical system operating at 15 KV (acceleration voltage) and transmission electron microscope (Transmission Electron Microscope, Hitachi H-7500, 120 kV) Scanning Electron Microscope images of Diamond Cellular Anti-Ageing Cream shows that the material mainly consisted of

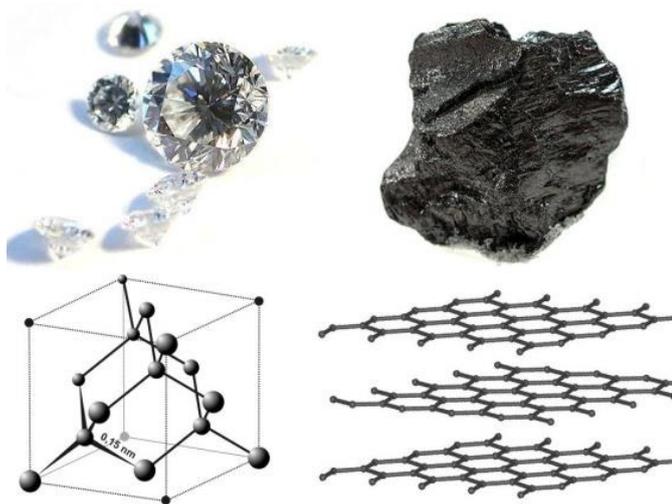
spherical particles with 5–10  $\mu\text{m}$  in diameter, and has a smaller aggregated particle size. Although the majority of material consists of micrometer or grains, smaller particles with nanoscale (10–20 nm) are also present in the TEM images. Transmission Electron Microscope images of Diamond Cellular Anti-Ageing Cream shows that the material mainly consisted of spherical particles with 10–20 nm in diameter, and has a smaller aggregated particle size. Investigations well confirm the presence of diamond crystals with nanometric size between 10 and 20 nm. FTIR can be routinely used to identify the functional groups and identification/quality control of raw material/finished products. FTIR spectra of Diamond Cellular Anti-Ageing Cream is obtained at room temperature by using an FTIR Spectrophotometer - Perkin Elmer - Spectrum RX-IFTIR. The spectra is collected in a range from 650 to 4000  $\text{cm}^{-1}$ . Interpretation of FTIR Spectra of Diamond Cellular Anti-Ageing Cream shows presence of various functional groups such as Alkane - Ethyl, n - propyl, Iso propyl, tertiary butyl; Alkene - Vinyl  $-\text{CH}=\text{CH}_2$ ,  $-\text{CH}-\text{CH}-$  (Trans),  $-\text{CH}-\text{CH}-$  (Cis),  $>\text{CH}=\text{CH}_2$ ,  $>\text{CH}=\text{CH}-$ ; Acids - Carboxylic acids  $\text{COOH}$ ; Alcohols - Primary alcohols  $\text{CH}_2-\text{OH}$ , Secondary  $\text{CH}-\text{OH}$ , Aromatic  $\text{C}_6\text{H}_5-\text{OH}$ ; Aldehydes - Aliphatic Aldehydes  $-\text{CH}_2\text{CHO}$ , Aromatic Aldehydes  $\text{C}_6\text{H}_5-\text{CHO}$ ; Anhydrides - Normal anhydrides  $\text{C}-\text{CO}-\text{O}-\text{CO}-\text{C}$ , Cyclic anhydrides ; Aromatic - Meta disubstituted Benzene ,

Vicinal trisubstituted Benzene , Monosubstituted Benzene  $\text{C}_6\text{H}_5-$ ; Amides - Amide  $-\text{CO}-\text{NH}_2$ ; Amines -  $\text{C}_6\text{H}_5-\text{NH}_2$ , Primary amines  $\text{CH}_2-\text{NH}_2$ ; Amines (Cont) - Hydrochloride  $\text{C}-\text{NH}_3^+\text{Cl}^-$ ; Imines - Substituted Imines  $>\text{C}=\text{N}-\text{C}$ ; Ethers - Aliphatic ethers  $\text{CH}_2-\text{O}-\text{CH}_2$ , Aromatic Ethers -  $\text{C}_6\text{H}_5-\text{O}-\text{CH}_2$ ; Esters - Acetates  $-\text{CH}_2-\text{CO}-\text{O}-\text{R}$ , Acrylates  $=\text{CH}-\text{CO}-\text{O}-\text{R}$ , Fumarates  $=\text{CH}-\text{CO}-\text{O}-\text{R}$ , Maleates  $=\text{CH}-\text{CO}-\text{O}-\text{R}$ , Benzoates, phthalates  $\text{C}_6\text{H}_4-\text{CO}-\text{O}-\text{R}$ . an important source of error in determining the flow of the electric current to estimate body fat. It is important to know our biological age. If we know where the problems exist, we can initiate the lifestyle modifications necessary to improve our health and increase our vitality. Maintaining an ideal weight can help prevent obesity or weight loss and other diseases, and lead a longer life. We should build up non-fat physique by increasing skeletal muscle and improving resting metabolism. Complementing exercise along with a proper diet is the key to a healthy lifestyle. In today's world, exercising routine is regarded imperfect without vital elements called Bodybuilding supplements. They act as a fuel for our body and boost sporting performance. Herbalife is a world leader in the wellness industry. Their products do detoxification and cleansing of body systems from the inside, weight management, supplementation, anti-aging, prevent future diseases. Among these are Aloe Plus Tablet, Afresh, Cell -U -Loss Tablet, Personalized Protein Powder, Nutritional Shake Mix, Multivitamin Mineral and Herbal Tablet, Cell Activator Tablet, Activated Fiber Tablet for better weight management.

**Key words :** Diamond Cellular Anti-Ageing Cream, Diamond Elixir, Scanning Electron Microscope (SEM) images, Transmission Electron Microscope (TEM) images, FTIR spectra.

## INTRODUCTION

A diamond is transparent crystal of tetrahedrally bonded carbon atoms in a covalent network lattice ( $sp^3$ ) that crystallizes into the diamond lattice which is a variation of the face centered cubic structure. Diamonds have been adapted for many uses because of the material's exceptional physical characteristics. Most notable are its extreme hardness and thermal conductivity ( $900\text{--}2320\text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ ) [1], as well as wide band gap and high optical dispersion [2]. Above  $1700\text{ }^\circ\text{C}$  ( $1973\text{ K}$  /  $3583\text{ }^\circ\text{F}$ ) in vacuum or oxygen-free atmosphere, diamond converts to graphite; in air, transformation starts at  $\sim 700\text{ }^\circ\text{C}$  [3]. Diamond's ignition point is  $720\text{--}800\text{ }^\circ\text{C}$  in oxygen and  $850\text{--}1000\text{ }^\circ\text{C}$  in air. Naturally occurring diamonds have a density ranging from  $3.15\text{--}3.53\text{ g/cm}^3$ , with pure diamond close to  $3.52\text{ g/cm}^3$  [4]. The chemical bonds that hold the carbon atoms in diamonds together are weaker than those in graphite. In diamonds, the bonds form an inflexible three-dimensional lattice, whereas in graphite, the atoms are tightly bonded into sheets, which can slide easily over one another, making the overall structure weaker [5]. In a diamond, each carbon atom is surrounded by neighboring four carbon atoms forming a tetrahedral shaped unit.



**Figure 1. Diamond and graphite samples with their respective structures - Diamond and graphite are two allotropes of carbon: pure forms of the same element that differ in structure.**

Diamonds are naturally lipophilic and hydrophobic, which means the diamonds' surface cannot be wet by water but can be easily wet and stuck by oil. This property can be utilized to extract diamonds using oil when making synthetic diamonds. However, when

diamond surfaces are chemically modified with certain ions, they are expected to become so hydrophilic that they can stabilize multiple layers of water ice at human body temperature [6].

Porous diamond foam exhibiting a three-dimensional structure was synthesized by applying prolonged Bias Enhanced Nucleation on iridium buffer layers. The Raman spectrum of this material recorded at  $325\text{ nm}$  looks very close to the signature obtained for detonation nanodiamonds. HRTEM investigations well confirm the presence of diamond crystals with nanometric size between  $2$  and  $6\text{ nm}$ . All these diamond nanocrystals form a three-dimensional structure very different from ultrananocrystalline diamond (UNCD) generally embedded in a graphitic matrix. According to its high specific surface area, such a 3D material may have promising applications for sensors [7].

Diamond properties are significantly affected by crystallite size. High surface to volume fractions result in enhanced disorder,  $sp^2$  bonding, hydrogen content and scattering of electrons and photons. Most of these properties are common to all low dimensional materials, but the addition of carbon allotropes introduces  $sp^2$  bonding, a significant disadvantage over systems such as amorphous silicon. Increased  $sp^2$  bonding results in enhanced disorder, a significantly more complex density of states within the bandgap, reduction of Young's modulus, increased optical absorption etc. At sizes below  $10\text{ nm}$ , many diamond particle and film properties deviate substantially from that of bulk diamond, mostly due not only to the contribution of  $sp^2$  bonding, but also at the extreme low dimensions due to size effects. Despite these drawbacks, nano-diamond films and particles are powerful systems for a variety of applications and the study of fundamental science. Knowledge of the fundamental properties of these materials allows a far greater exploitation of their attributes for specific applications [8].

**Diamonds**, the most precious gemstones, have been widely recognized for their exceptional powers and miraculous therapeutic abilities. In ancient times diamonds were regarded as the gemstones of Venus, the Roman goddess that represents beauty, love, and fertility. In modern times diamonds are considered as a symbol of purity and perfection. Diamonds are considered in different cultures to have some therapeutic powers and in alternative medicine, diamonds are

known for strengthening all the energy centers of the human body.

Some of the hottest trends nowadays in the beauty industry are when high-end, professional salons and spas offer Diamond microdermabrasion treatments based on spa diamond tip equipment. These are very effective treatments that require several visits to the spa or salon. Another recent hot trend in top salons and spas is Diamond Peeling, in which the aesthetician uses diamond crystals and powder throughout the facial treatment. These kinds of treatments are very effective and common by celebrities but are generally very expensive.

This review attempts to guide the reader between the various micro and nanocrystalline diamond skin care products and their applications, with a particular focus on Diamond Cellular Anti-Ageing Cream. Paper also deals with Scanning Electron Microscope (SEM) images, Transmission Electron Microscope (TEM) images and FTIR spectra of Diamond Cellular Anti-Ageing Cream. This research, along with better regulation and reporting, will enable consumers to choose products with confidence. This in turn will allow companies to benefit from these novel technologies in the long term while retaining customer confidence.

### 1. Diamond Cellular Anti-Ageing Cream

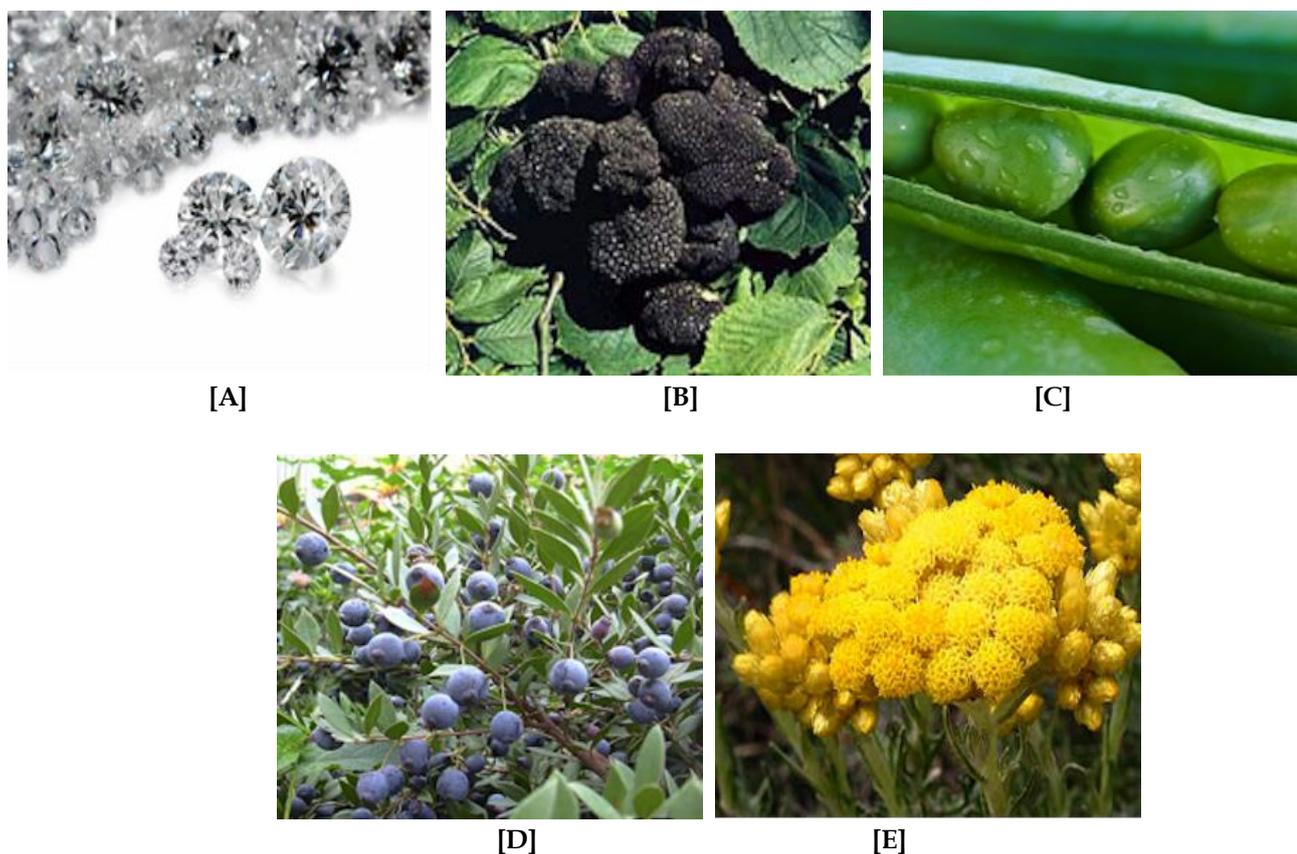
Diamond Cellular Anti-Ageing Cream combines advanced technology with luxurious ingredients to target all the effects of ageing for younger looking skin. It provides all the skin's needs in one product. With this skin appears younger, firmer and brighter, wrinkles and the fine lines appear plumped out, facial contours look redefined. This exceptional beauty treatment contains a Diamond Elixir and an Eternal Beauty Complex that work together to fight against the visible signs of ageing for a younger looking skin.

Key Ingredients of Diamond Cellular Anti-Ageing Cream include: Diamond Elixir. It is composed of: Diamond Powder (Diamond Powder): to brighten and soothe the skin; White Truffle (Tuber Aestivum Extract): helps to improve skin complexion whilst having a tonifying and smoothing effect on wrinkles; and Skin brightening active (Pisum Sativum Extract): helps reduce uneven pigmentation and improve skin complexion.

All Ingredients of Diamond Cellular Anti-Ageing Cream include: Aqua, bis-hydroxyethoxypropyl dimethicone, caprylic/capric triglyceride, butylene glycol, glycerin, isononyl isononanoate, pentaerythrityl distearate, dimethicone, cyclopentasiloxane, c20-22 alkylphosphate, aluminum starch octenylsuccinate, c20-22 alcohols, stearyl alcohol, dimethicone/vinyl dimethicone crosspolymer, cetyl alcohol, sucrose dilaurate, parfum, sodium acrylate/sodium acryloyldimethyl taurate copolymer, methylparaben, dimethiconol, imidazole-dinyl urea, palmitoyl proline, isohexadecane, propylparaben, synthetic fluorophlogopite, polysorbate 20, sodium hydroxide, diamond powder, disodium edta, magnesium palmitoyl glutamate, sodium palmitoyl sarcosinate, sodium polyacrylate, polysorbate 80, pisum sativum extract, phenoxyethanol, silica, carbomer, isoceteth-10, sodium lactate, caprylyl glycol, sorbitan oleate, p-anisic acid, sodium citrate, sorbic acid, myrtus communis extract, tuber aestivum extract, potassium sorbate, helichrysum stoechas extract, chlorphenesin, ergothioneine, palmitoyl tripeptide-1, sodium benzoate, ethylhexylglycerin, palmitoyl tetrapeptide-7, pogostemon cablin oil, citric acid, ci 77891.

**Diamond Elixir:** Diamond Elixir contains the most luxurious ingredients, combined with a targeting active to bring luminosity and evenness to the skin by helping to combat discoloration and dullness. Diamond Elixir composed of Diamond powder which helps to brighten and soothe the skin; White truffle (Tuber Aestivum Extract) which helps to improve skin complexion whilst having a tonifying and smoothing effect on wrinkles; Skin brightening active (Pisum Sativum Extract) which reduces uneven pigmentation revealing an evened-out skin tone and improves skin complexion.

**Eternal Beauty Complex:** Eternal Beauty Complex is composed of state-of-the-art anti-ageing and anti-oxidants actives to help reinforce skin natural defenses whilst retexturing and smoothing skin surface. Myrtle extract acts at a cellular level to extend cell life, restore cell production and limit the loss of essential proteins such as collagen, thus helping to increase cell longevity and diminish cell ageing. Protein complex stimulates skin cells and restore cell function. It increases skin firmness and has been proven to significantly reduce wrinkles. Flavonoids help to soothe skin after exposure to damaging free radicals [9].



**Figure 2. Key ingredients that stand out in oriflame diamond cellular anti-ageing cream: [A] Diamond Powder [B] Tuber Aestivum Extract [C] Pisum Sativum Extract [D] Myrtus Communis Extract [E] Helichrysum Stoechas Extract [10].**

A cosmetic product is provided, which is directed at improving infrared radiation effects, charged particle emission and ultraviolet blocking effects. Diamond powder formed by shockwaves is suitably blended with a cosmetic product and specific infrared wavelengths and charged particle emission characteristics generated by the semiconductor characteristics thereof are used. An inorganic oxide powder may be added as needed, so as to produce characteristics that are beneficial for cosmetic materials such as foundations, powders, gels, lipsticks, eye shadows, and manicure products [11].

The invention relates to a cosmetic preparation containing an active complex comprised of extracts. The active complex contains at least one starting substance, which is extracted as an aqueous extract from real truffles (Tuberaceae) and which is provided in a cosmetically acceptable gel while being stabilized. A preferred active complex is one that additionally contains a champagne product. Cosmetic preparations containing this active complex lead to an improved stimulation of the immune system, an improved

regenerative effect and thus to an improved balance in the ecosystem of the skin [12].

An active botanical extract derived from seeds of *Pisum sativum L.*, pea extract keeps specific enzymes known as proteases from degrading skin proteins such as collagen and elastin which are responsible for giving skin its firmness and elasticity. It can therefore protect collagen and elastin against the damaging effects of proteases activated by aging and through different types of skin abuse (UV, chemical, immunological, etc). Used in skin care products, pea extract acts as an anti-enzyme complex and gives the skin its firmness and elasticity. A clinical study has demonstrated significant improvement in skin elasticity (+16.7%) after just three weeks of treatment [13].

The contents of phenolic compounds in seed coat of pea and their antioxidative properties were examined. Strong antioxidative properties were noted for extract [14].

The dimeric nonprenylated acylphloroglucinol semimyrtucommulone was obtained from the leaves of myrtle (*Myrtus communis*). The known trimeric phloroglucinol myrtucommulone A was also isolated and characterized spectroscopically as a silylated cyclized derivative. Myrtucommulone A showed significant antibacterial activity against multidrug-resistant (MDR) clinically relevant bacteria, while semimyrtucommulone was less active [15].

The invention relates to novel compositions, such as cosmetic compositions, containing a myrtle extract, and their uses for depigmenting purposes [16].

Helichrysum Extract is produced from the flowers of the Helichrysum stoechas plant. The Helichrysum flower contains compounds that have antioxidant and antimicrobial activity. These compounds include flavonoids, acetophenone derivatives, monoterpenes, sesquiterpenes, triterpenes and phytosterols. Flavonoids and acetophenones are the primary antioxidants and serve as free radical scavengers and help to prevent ROS formation. In addition to antioxidant activity, Helichrysum Extract ECOCERT also demonstrates antimicrobial, anti-inflammatory, and purifying activity primarily due to the essential oil components [17].

## 2. Diamond Cellular Micellar Solution Cleanser

It is luxurious all-in-one cleanser, toner and make-up remover which removes make and impurities. It contains White Diamond Elixir which works by Micellar technology. With micellar technology impurities get effectively entrapped during cleansing thus it eliminates dirt and oil from the skin. Thus skin looks smooth and fresh with radiant complexion. It cleanses, tones and softens in one easy step. It is soap and alcohol free formula. Diamond Cellular offers luxurious anti-aging care containing a unique mix of Diamond Elixir with real diamond powder, and Eternal Beauty Complex to rejuvenate the skin at a cellular level.

Its Key ingredients include: White Diamond Elixir which consists of White Truffle (*Tuber Aestivum* Extract) which helps to improve skin complexion whilst having a tonifying and smoothing effect on wrinkles and Skin brightening active (*Pisum Sativum* Extract) which helps reduce uneven pigmentation and improve skins complexion. Micellar Technology (*Coco-Glucoside*) entraps impurities eliminating dirt and oil from the skin [18].

## 3. Diamond Cellular Night Restorative Treatment

This is high-performing night treatment with Cellular Sal Acid to help improve skin cell turnover, resulting in younger looking skin. It contains genuine diamond powder to brighten complexion. It reduces the appearance of fine lines and wrinkles, helps to lift and redefine facial contours, improves cell turnover. Diamond Cellular offers luxurious anti-aging care containing a unique mix of Diamond Elixir with real diamond powder.

Its key Ingredients include: Cellular Sal Acid which helps stimulate skin cell turnover and re-enforces the exfoliating action to promote younger looking complexion and Eternal Beauty Complex (combines 3 actives: Myrtle Extract, Protein Complex and Antioxidants) to retexture and smooth the surface of the skin whilst protecting from free radicals in the environment and helping to reinforce the skin's natural defenses [19].

## 4. Diamond Cellular Multi-Perfection Eye Treatment

It gives radiant and youthful looking skin around the eyes, containing Eternal Youth Complex that smoothes wrinkles and slows down the ageing process. It locks in moisture for youthful looking skin in the eye area; it eases blood circulation, improving the skins complexion; it acts on hyper pigmentation; it combats discolouration and dullness. Diamond Cellular offers luxurious anti-aging care containing a unique mix of Diamond Elixir with real diamond powder and Eternal Beauty Complex to rejuvenate the skin at a cellular level.

Its key Ingredients include Eternal Youth Complex which composed of state-of-art anti-ageing and moisturiser actives, combining Eye Renewal Peptide (Palmitoyl, Palmitoyl Oligopeptide, Glycerin, Tetrapeptide-7) which stimulates collagen production and helps restore cell function and Eye Hydro Protector which retains moisture balance in the top layer of the skin keeping it well hydrated; White Diamond Elixir which is composed of White Truffle (*Tuber Aestivum* Extract) it helps to improve skin complexion whilst having a tonifying and smoothing effect on wrinkles and Skin brightening active (*Pisum Sativum* Extract) which helps reduce uneven pigmentation and improve skin complexion; and Stimuflow (*Saccharomyces Cerevisiae* Extract) which eases the blood circulation in the skin around the eyes reducing the appearance of uneven complexion [20].

### 5. Precious Moments Eau de Parfum

Precious Moments Eau de Parfum dazzles with real diamond powder and glorious scent. It blossoms with succulent apple and wild berry notes married to a white floral heart. Warm precious woods soften the delicious scent. A gentle shake of the bottle activates the subtle shimmer that lingers on the skin [21].

### 6. Diamond Cellular Illuminating Exfoliator

It exfoliates and improves skin, smoothing away old skin cells and revealing radiant skin below. Diamond Elixir brightens, tonifies, and evens skin tone. Diamond particles polish skin for a healthy, younger look.

### 7. Diamond Cellular Concentrated Perfector

It is a dazzling blend of high performance and luxury fast-acting formula for instant luminosity which also combats the first signs of ageing. It is enriched with genuine diamond powder for smooth, shimmering skin.

### 8. Forever Flawless skin care products

Forever Flawless products contain a special ingredient, extra-fine natural diamond powder. Skin care products containing extra-fine diamond powder gently exfoliate the top layer of skin, allowing the vitamins, moisturizers, botanicals, and age-defying ingredients in their products to penetrate deeper and more effectively. This controlled diamond exfoliating process is supposed to improve the penetration of the age-defying ingredients in their products tremendously. As a result, regular use of the Forever Flawless skin care products usually generates a noticeably smoother, radiant, and younger looking skin.

Forever Flawless has taken luxury skincare, for personal use, to the next level by integrating diamond exfoliation and peeling benefits into their formulas. That is, in every use of their products there is a phase that includes a controlled diamond exfoliation and peeling. Then, in phase two, when the skin is ready the cream, serum, or mask penetrate deeper and more effectively into the skin for a better ultimate results. Overall, they try to offer similar benefits and experience of a high-end spa or salon at the comfort of one's home [22].

### 9. Celestial Black Diamond Cream

Using ground breaking research, Black Diamond microspheres infuse the deepest layers of the skin with NAC Y2, Arbutin and Hyaluronic Acid to brighten, plump and regenerate the skin. Celestial Black Diamond Cream is a restorative and brightening cream that improves the skin's elasticity and firmness [23].

Celestial Black Diamond Cream - This restorative and highly concentrated treatment combines technologically advanced ingredients with ground-breaking medical research to target ageing. The cream utilizes an innovative delivery system of rare diamond particles believed to have formed in space. Black diamond particles are microspheres that penetrate the deeper dermal layer of the skin in order to transport three essential youth restoring ingredients: patented NAC Y2 formula, Collagen type I and III and Hyaluronic acid.

On a cellular level, the cream regenerates the production of Glutathione, Hyaluronic Acid and Collagen in order to restore a youthful appearance. On a cellular level, the cream regenerates the production of these key cell-fortifying substances in order to restore a youthful appearance. In addition, the formula contains Arbutin, a brightening agent, which illuminates and rebuilds a healthy complexion. Its unique combination of age-defying ingredients supports the optimal function of the connective tissues and key enzymes in the cells.

Centella Asiatica stimulates the synthesis of collagen type I and III, NAC Y2 stimulates the ability of cells to regenerate and boosts the functions of the epidermis, Hyaluronic acid protects, captures, and retains moisture, Arbutin visibly brightens the skin, Vitamin E protects against the environmental changes, Hydroquinone-free, Paraben, paraffin, silicone and sulphate free [24].

### 10. Diamond Plus Skin Nourishing Cream

The ultimate in skin nourishment, the formulation is specially enhanced by advanced techniques. Ash of Diamond has been reinforced with organic extracts of vetiver, date, shea butter, tomato, olive oil and Vitamin E, to nourish and rejuvenate the skin powerfully. It helps to strengthen the supportive tissues, improving skin elasticity and making the skin firm and supple. Leaves the skin clear, radiant and youthful [25].

### 11. Shahnaz Husain Diamond Soap

With a gentle dermabrasive action, this natural formulation is specially designed for deep pore cleansing and exfoliation of the skin. It contains Diamond "bhasma" and oatmeal for exfoliation. It also contains rich emollients, moisturizers and natural beauty enhancers. Diamond is combined with saffron, turmeric, cucumber, rose, coconut oil. Provides protection and makes the skin appear radiant and youthful [26].

### 12. Diamond Plus Skin Rejuvenating Mask

Reinforced with highly specialized techniques, the formulation is a superb blend of ash of Diamond and precious organic extracts of masoorika, orange oil, aloe vera juice, rose water, Vitamin-E and honey. Specially designed for anti-ageing benefits, it helps to revitalize the skin and restore its youthful qualities. It promotes cell renewal and skin rejuvenation, leaving the skin with a youthful, healthy glow [27].

### 13. Diamond Plus Rehydrant Lotion

Specially enhanced with organic extracts combined with ash of Diamond, the formulation provides intensive moisturisation and age control benefits. Containing extracts of carrot seed, date, basil, aloe vera juice and grapefruit, with Vitamin E and honey, it helps to hydrate the skin powerfully and restore its smooth youthful beauty. Improves moisture retention and leaves the skin soft and glowing [28].

### Other features of this microscope are:

Resolution	=	4.0 nm at 8mm working distance
Working distance	=	6 to 48 mm
Accelerating Voltage	=	0.3 to 30 KV
Magnification	=	x10 to x300,000
Image Recording	=	on 120 B&W Roll Film (100 ASA) or 35mm B&W roll (25 ASA)
Instant Print	=	an instant print is also possible on a Thermal Video Printer (8x10.5)

### Transmission Electron Microscope (TEM) - Hitachi (H-7500) 120 kV

TEM is analogous to the optical microscope. It provides very high resolution which can reach approximately 0.1 nm in the case of lattice images. Consequently very high magnification (Close to 1 million times) can be obtained. TEM is used to examine very thin sections (<60 nm in thickness) through the cells and tissues or through materials as well as replicas of the surfaces of the samples.

A Transmission Electron Microscope, Hitachi (H-7500) 120 kV is used with CCD Camera This instrument has the resolution of 0.36 nm (point to point) with 40-120 kV operating voltage and can magnify object up to 6 lakh times in High Resolution mode. It has Electron Diffraction, Tungsten Filament, Low Dose Function, High Contrast Mode with ergodynamic look. The

### 14. Diamond Plus Exfoliating Scrub

A premium formulation for advanced skin care, it is a unique combination of ash of Diamond and organic extracts and oils. Specially created to exfoliate the skin on face and body, it helps to remove dead epithelial cells and speed up the cell renewal process. Enriched with almond, olive, coconut and apricot oils, along with cucumber seed, aloe vera juice, lemon peel, date, Vitamin E and honey, the formulation cleanses, refines and revitalizes the skin, enhancing its youthful beauty and radiance [29].

### 15. Black Diamond Hair Serum

A highly advanced formulation containing the rare Black Diamond, it is specially created to revitalize the hair powerfully. In serum form and blended with precious plant extracts and oils, it moisturizer and nourishes the hair, making it appear smooth, thick, healthy and lustrous, with added body and shine [30].

specific features of the instrument are: maximum field of views at x700 with dual picture modes, Auto-navigation, Largest possible field with mose contrast, auto pre-irradiation mode (APIS). The equipment has provision for future up-gradation for an analytical system by adding EELS, EDS and STEM attachments.

### FTIR Spectrophotometer - Perkin Elmer - Spectrum RX-IFTIR

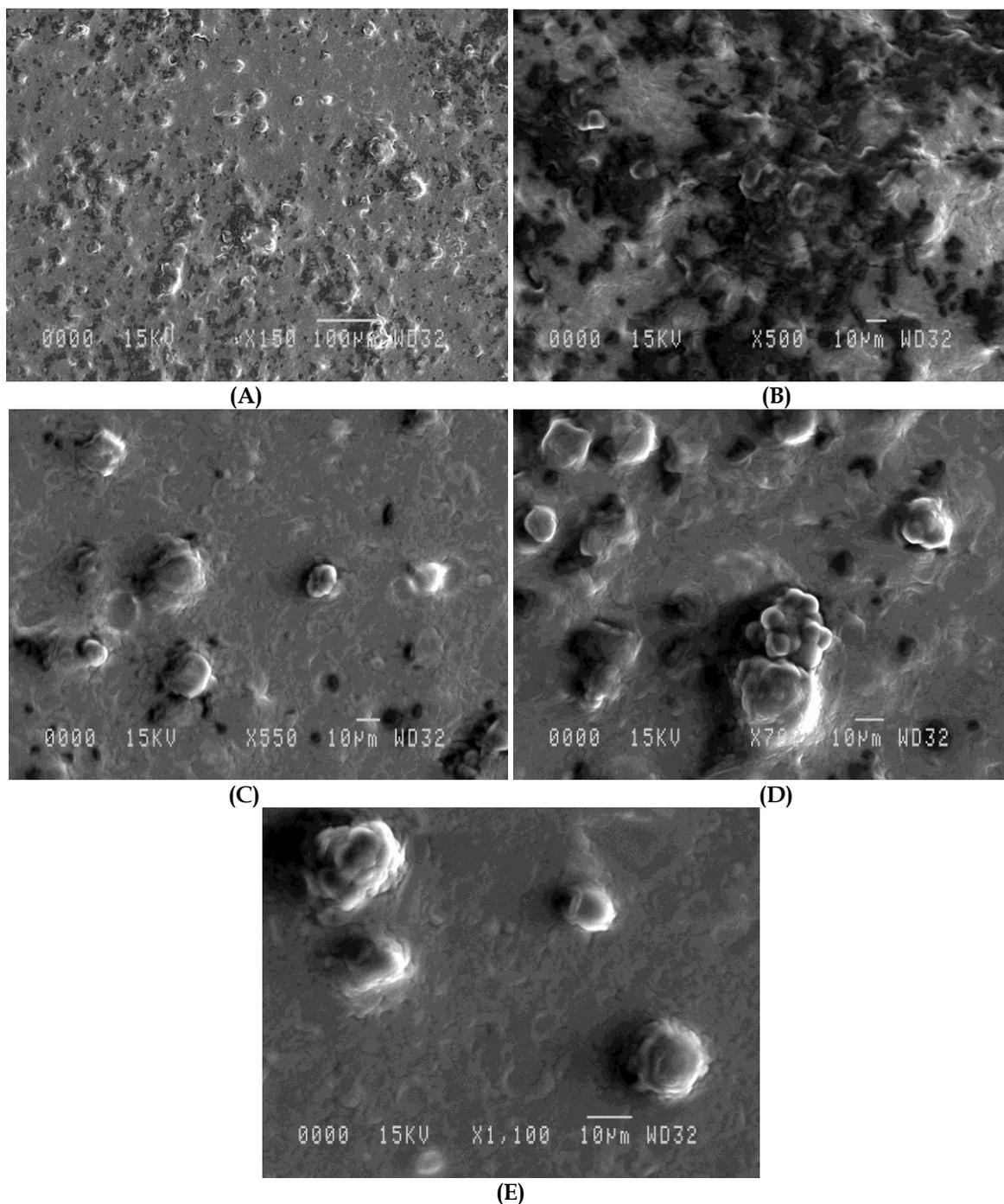
FTIR can be routinely used to identify the functional groups and identification/quality control of raw material/finished products. Spectrum RX-I offers fast throughput and rapid access to reliable and dependable IR results. High signal to noise ratio makes FTIR more useful for difficult samples. It has resolution of 1  $\text{cm}^{-1}$  and scan range of 4000  $\text{cm}^{-1}$  to 250  $\text{cm}^{-1}$ . In the normal mode around 10 mg sample is required in the form of

fine powder. The sample can be analyzed in the form of liquid, solid and thin films also.

FTIR spectra of Diamond Cellular Anti-Ageing Cream is obtained at room temperature by using an FTIR Spectrophotometer - Perkin Elmer - Spectrum RX-IFTIR. The spectra is collected in a range from 650 to 4000  $\text{cm}^{-1}$ .

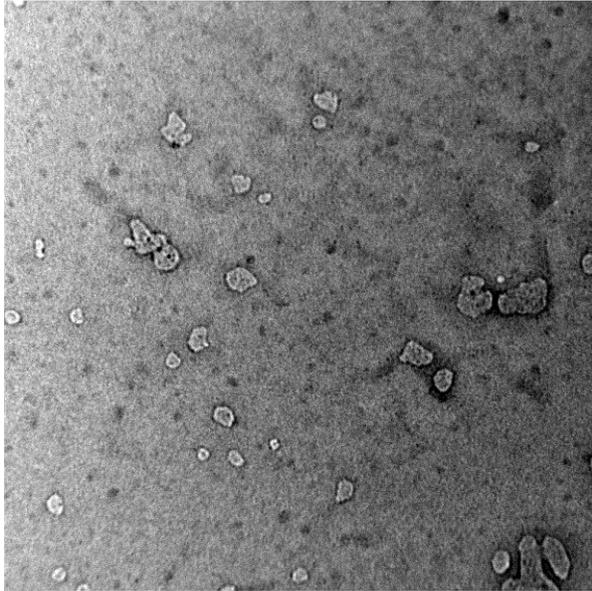
## RESULTS AND DISCUSSION

Interpretation of FTIR Spectra of Diamond Cellular Anti-Ageing Cream shows presence of various functional groups such as Alkane - Ethyl, n - propyl, Iso propyl, tertiary butyl; Alkene - Vinyl  $-\text{CH}=\text{CH}_2$ ,  $-\text{CH}-\text{CH}-$  (Trans),  $-\text{CH}-\text{CH}-$  (Cis),  $>\text{CH}=\text{CH}_2$ ,  $>\text{CH}=\text{CH}-$ ; Acids -



**Figure 3 (A) - (E) . Scanning Electron Microscope images of Diamond Cellular Anti-Ageing Cream**

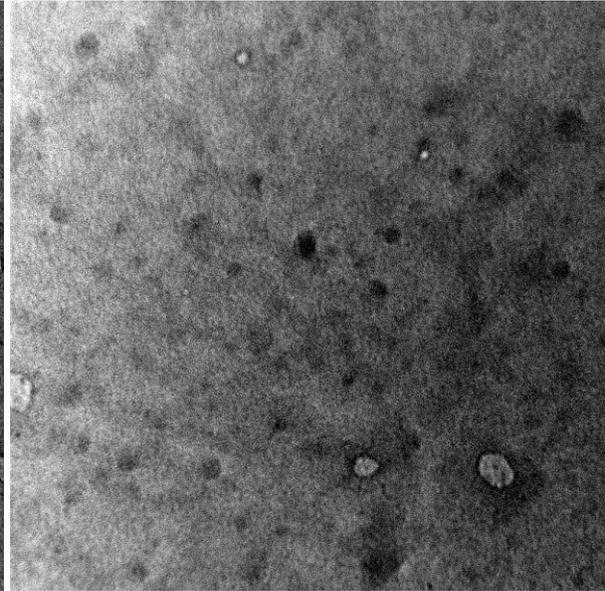
(A) - (E) shows Scanning Electron Microscope images of Diamond Cellular Anti-Ageing Cream. We can learn from Figure 3 (A) - (E) that the material mainly consisted of spherical particles with 5-10  $\mu\text{m}$  in diameter, and has a smaller aggregated particle size. Although the majority of material consists of micrometer or grains, smaller particles with nanoscale (10-20 nm) are also present in the TEM images (Fig. 4 C to H).



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AMT Camera System

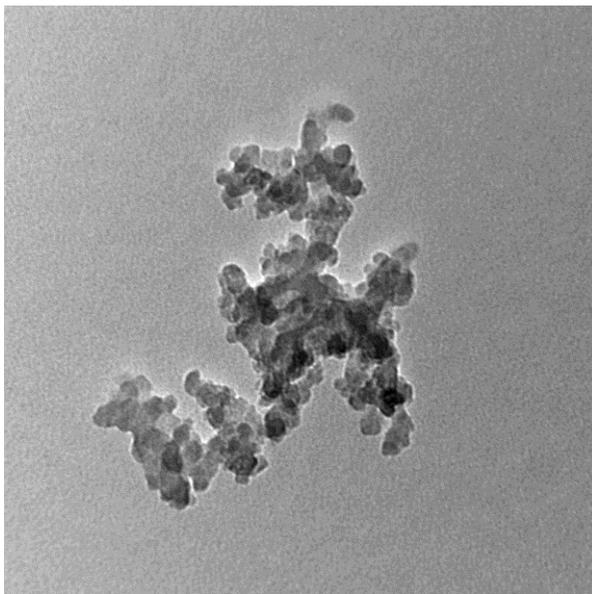
(A)



1AC.tif  
Print Mag: 347000x @ 7.0 in  
12:29:07 p 07/04/16

100 nm  
HV=100.0kV  
Direct Mag: 200000x  
AMT Camera System

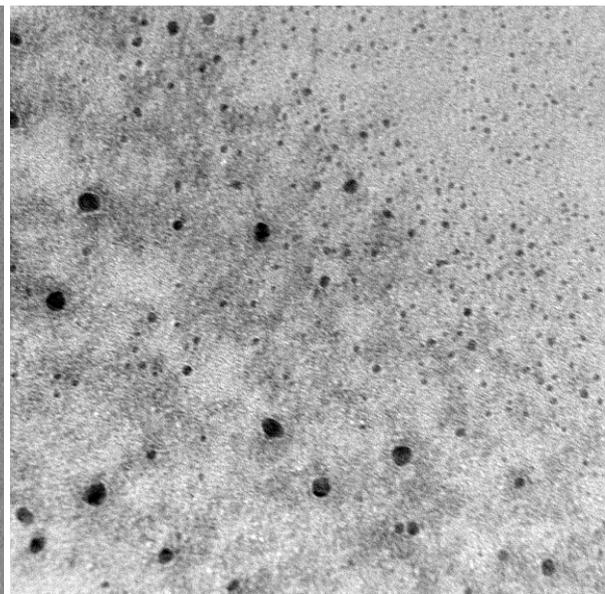
(B)



1AE.tif  
Print Mag: 521000x @ 7.0 in  
12:31:31 p 07/04/16

20 nm  
HV=100.0kV  
Direct Mag: 300000x  
AMT Camera System

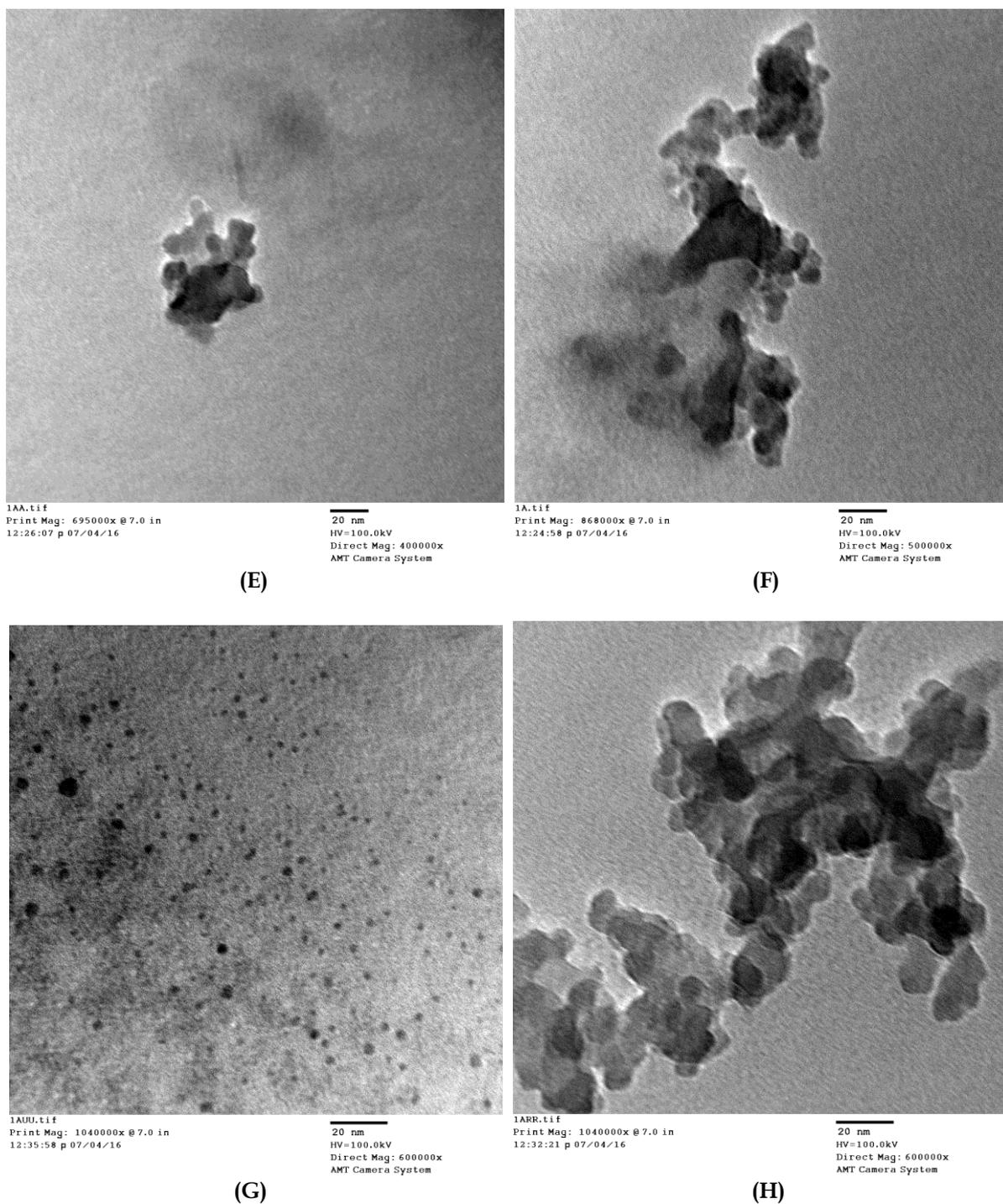
(C)



1ACUF.tif  
Print Mag: 695000x @ 7.0 in  
12:34:59 p 07/04/16

20 nm  
HV=100.0kV  
Direct Mag: 400000x  
AMT Camera System

(D)



**Figure 4 (A) - (H) . Transmission Electron Microscope images of Diamond Cellular Anti-Ageing Cream**

Figure 4 (A) - (H) shows Transmission Electron Microscope images of Diamond Cellular Anti-Ageing Cream. These figures shows that the material mainly consisted of spherical particles with 10-20 nm in diameter, and has a smaller aggregated particle size.

Investigations well confirm the presence of diamond crystals with nanometric size between 10 and 20 nm.

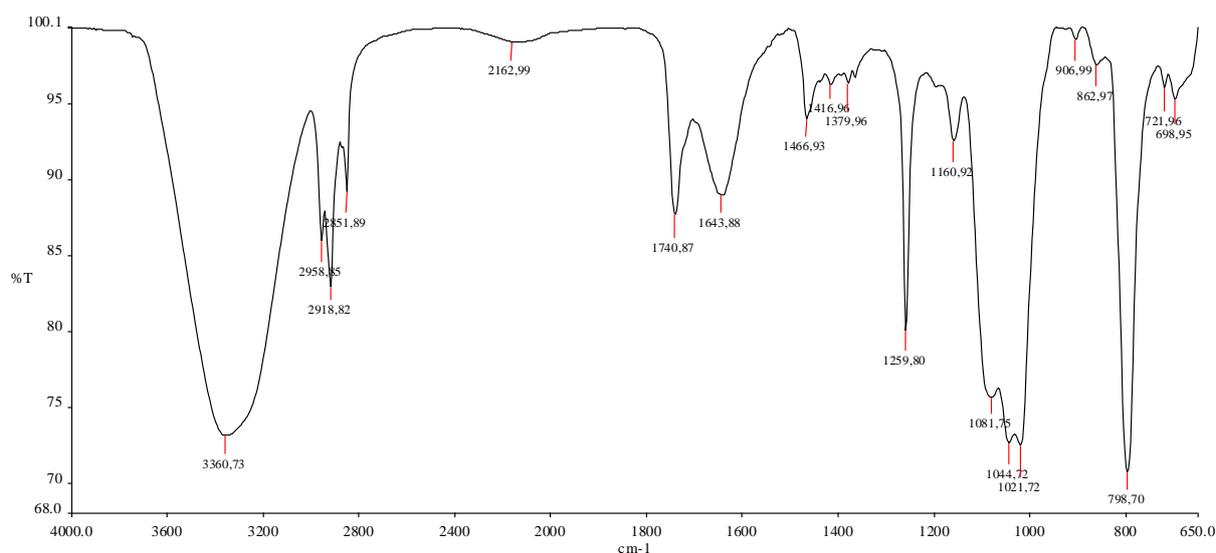


Figure 5. FTIR Spectra of Diamond Cellular Anti-Ageing Cream

Interpretation of FTIR Spectra of Diamond Cellular Anti-Ageing Cream can be done as follows:

S.N.	Spectral Wave cm <sup>-1</sup>	Region number	Bond causing absorption	Pattern and Intensity of Band
1	3360.73		Alcohols - Secondary CH-OH	Broad and Strong Intensity
2	2958.85		Alkane - Iso propyl, tertiary butyl	Sharp and Moderate Intensity
3	2918.82		Alkane - Iso propyl, tertiary butyl	Sharp and Moderate Intensity
4	2851.89		Alkane - Ethyl, n - propyl, tertiary butyl Aldehydes - Aliphatic Aldehydes -CH <sub>2</sub> CHO, Aromatic Aldehydes <chem>C1=CC=CC=C1</chem> -CHO	Sharp and Moderate Intensity
5	2162.99		-	Broad and Low Intensity
6	1740.87		-	Sharp and Moderate Intensity
7	1643.88		Alkene - Vinyl -CH=CH <sub>2</sub> , -CH-CH- (Trans), -CH-CH- (Cis), >CH=CH <sub>2</sub> , >CH=CH- Aromatic - Monosubstituted Benzene <chem>C1=CC=CC=C1</chem> - Amides - Amide -CO-NH <sub>2</sub> Amines (Cont) - Hydrochloride C-NH <sub>3</sub> <sup>+</sup> Cl <sup>-</sup> Imines - Substituted Imines >C=N-C	Broad and Moderate Intensity
8	1466.93		Alcohols - Primary alcohols CH <sub>2</sub> -OH	Broad and Low Intensity
9	1416.96		Alcohols - Primary alcohols CH <sub>2</sub> -OH	Broad and Low Intensity
10	1379.96		-	Broad and Low Intensity
11	1259.8		Ethers - Aromatic Ethers - <chem>C1=CC=CC=C1</chem> -O-CH <sub>2</sub> Alcohols - Aromatic <chem>C1=CC=CC=C1</chem> -OH Acids - Carboxylic acids COOH Esters - Acetates -CH <sub>2</sub> -CO-O-R, Acrylates =CH-CO-O-R, Fumarates =CH-CO-O-R, Maleates =CH-CO-O-R, Benzoates, phthalates <chem>C1=CC=CC=C1</chem> -CO-O-R	Sharp and Strong Intensity

		Anhydrides - Cyclic anhydrides  Amines - 	
12	1160.92	Aromatic - Monosubstituted Benzene 	Broad and Low Intensity
13	1081.75	Ethers - Aliphatic ethers $\text{CH}_2\text{-O-CH}_2$ Alcohols - Primary alcohols $\text{CH}_2\text{-OH}$ Esters - Benzoates, phthalates  -CO-O-R Anhydrides - Normal anhydrides C-CO-O-CO-C	Broad and Strong Intensity
14	1044.72	Alcohols - Primary alcohols $\text{CH}_2\text{-OH}$	Broad and Strong Intensity
15	1021.72	Alcohols - Primary alcohols $\text{CH}_2\text{-OH}$	Broad and Strong Intensity
16	906.99	Alkane - n-propyl, Iso propyl, tertiary butyl	Broad and Low Intensity
17	862.97	Alkane - Ethyl, n-propyl	Broad and Low Intensity
18	798.7	Alkene - -CH-CH- (Cis), >CH=CH- Aromatic - Meta disubstituted Benzene  , Vicinal trisubstituted Benzene  Amines - Primary amines $\text{CH}_2\text{-NH}_2$	Sharp and Strong Intensity
19	721.96	Aromatic - Meta disubstituted Benzene  , Vicinal trisubstituted Benzene 	Broad and Low Intensity
20	698.95	Aromatic - Meta disubstituted Benzene  , Vicinal trisubstituted Benzene 	Broad and Low Intensity

Carboxylic acids  $\text{COOH}$ ; Alcohols - Primary alcohols  $\text{CH}_2\text{-OH}$ , Secondary  $\text{CH-OH}$ , Aromatic -OH;  
Aldehydes - Aliphatic Aldehydes  $\text{-CH}_2\text{CHO}$ , Aromatic Aldehydes -CHO; Anhydrides - Normal anhydrides C-CO-O-CO-C, Cyclic anhydrides ; Aromatic - Meta disubstituted Benzene , Vicinal trisubstituted Benzene , Monosubstituted Benzene -;  
Amides - Amide  $\text{-CO-NH}_2$ ; Amines - - $\text{NH}_2$ , Primary amines  $\text{CH}_2\text{-NH}_2$ ; Amines (Cont) - Hydrochloride C- $\text{NH}_3^+\text{Cl}^-$ ;  
Imines - Substituted Imines  $\text{>C=N-C}$ ; Ethers - Aliphatic ethers  $\text{CH}_2\text{-O-CH}_2$ , Aromatic Ethers - -O- $\text{CH}_2$ ; Esters - Acetates  $\text{-CH}_2\text{-CO-O-R}$ , Acrylates  $\text{=CH-CO-O-R}$ , Fumarates  $\text{=CH-CO-O-R}$ , Maleates  $\text{=CH-CO-O-R}$ , Benzoates, phthalates -CO-O-R.

## CONCLUSION

Scanning Electron Microscope images of Diamond Cellular Anti-Ageing Cream shows that the material mainly consisted of spherical particles with 5-10  $\mu\text{m}$  in diameter, and has a smaller aggregated particle size. Although the majority of material consists of micrometer or grains, smaller particles with nanoscale (10-20 nm) are also present in the TEM images.

Transmission Electron Microscope images of Diamond Cellular Anti-Ageing Cream shows that the material mainly consisted of spherical particles with 10-20 nm in diameter, and has a smaller aggregated particle size.

Investigations well confirm the presence of diamond crystals with nanometric size between 10 and 20 nm.

FTIR can be routinely used to identify the functional groups and identification/quality control of raw material/finished products.

Interpretation of FTIR Spectra of Diamond Cellular Anti-Ageing Cream shows presence of various functional groups such as Alkane - Ethyl, n - propyl, Iso propyl, tertiary butyl; Alkene - Vinyl  $-\text{CH}=\text{CH}_2$ ,  $-\text{CH}-\text{CH}-$  (Trans),  $-\text{CH}-\text{CH}-$  (Cis),  $>\text{CH}=\text{CH}_2$ ,  $>\text{CH}=\text{CH}-$ ; Acids - Carboxylic acids  $\text{COOH}$ ; Alcohols - Primary alcohols  $\text{CH}_2-\text{OH}$ , Secondary  $\text{CH}-\text{OH}$ , Aromatic   $-\text{OH}$ ; Aldehydes - Aliphatic Aldehydes  $-\text{CH}_2\text{CHO}$ , Aromatic Aldehydes   $-\text{CHO}$ ; Anhydrides - Normal anhydrides  $\text{C}-\text{CO}-\text{O}-\text{CO}-\text{C}$ , Cyclic anhydrides ; Aromatic - Meta disubstituted Benzene , Vicinal trisubstituted Benzene , Monosubstituted Benzene ; Amides - Amide  $-\text{CO}-\text{NH}_2$ ; Amines -   $-\text{NH}_2$ , Primary amines  $\text{CH}_2-\text{NH}_2$ ; Amines (Cont) - Hydrochloride  $\text{C}-\text{NH}_3^+\text{Cl}^-$ ; Imines - Substituted Imines  $>\text{C}=\text{N}-\text{C}$ ; Ethers - Aliphatic ethers  $\text{CH}_2-\text{O}-\text{CH}_2$ , Aromatic Ethers -   $-\text{O}-\text{CH}_2$ ; Esters - Acetates  $-\text{CH}_2-\text{CO}-\text{O}-\text{R}$ , Acrylates  $=\text{CH}-\text{CO}-\text{O}-\text{R}$ , Fumarates  $=\text{CH}-\text{CO}-\text{O}-\text{R}$ , Maleates  $=\text{CH}-\text{CO}-\text{O}-\text{R}$ , Benzoates, phthalates   $-\text{CO}-\text{O}-\text{R}$ .

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