

Nanoscience in Dermatology and Cosmetic Products

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المشرف العام – مركز الجلد والحساسية

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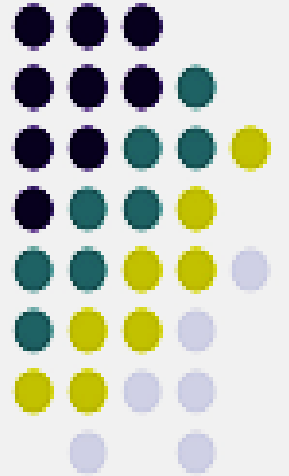
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Jeddah Dermatology & Cosmetics Conference

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Nanoscience in Dermatology and Cosmetic Products

Abstract:

Nanoscience is the study of **phenomena, performance and manipulation** of materials at **atomic, molecular and macromolecular scales**, where the **properties** differ significantly from those at larger scale. Nanomedicine is one of the most active research areas of nanotechnology; it applies this technology for **prevention, diagnosis and treatment** of diseases. The advantages of using nanoparticles as drug carrier systems are **:(A)increasing drug half-life, (B)reducing immunogenicity (C)improving bioavailability**. Expanding and successful use of topical Nanosilver is due to its **antimicrobial** effect and ability to induce **stem cell** activation, for treating skin infections, burns,infected wound, diabetic foot and non-healing ulcers. The applications of Nanoscience are found in many **cosmetic** products including moisturizers, **hair care** products, **sunscreen** and **make up**. In this review I will discuss and throw light on the different applications and Usage of **Nanoengineered** materials for skin diseases and cosmetics.



Nanoscience in Dermatology and Cosmetic Products

❖ تعني كلمة نانو باللغة اليونانية " قزم "

. وهي مشتقة من نانو متر **Nanometer** وهي وحدة قياس

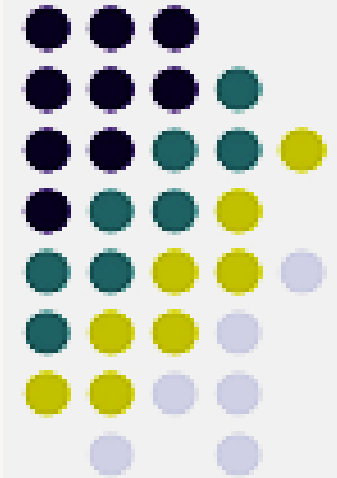
كيف يمكننا أن نتصور حجم النانو المادة المتناهية الصغر ؟

هي واحد على البليون من المتر **one billionth of a**

meter

أو واحد على المليون من المليمتر **one millionth of a**

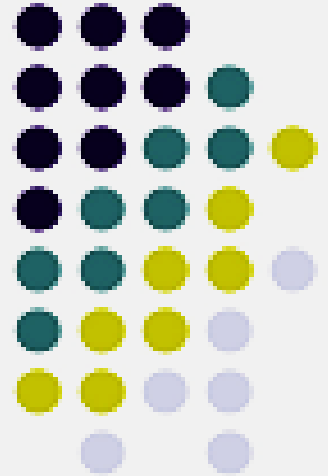
millimeter



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❖ تعريف علم (النانو) :

القدرة في التحكم التام والدقيق في انتاج المواد المتناهية الصغر من خلال التحكم في تفاعل الجزيئات وتوجيهها لإنتاج مادة معينة وبخصائص مختلفة لتصبح أكثر دقة ونقاوة وفعالية من الطرق التقليدية .



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❖ Nanoscience is the study of phenomena, performance and manipulation of materials at atomic, molecular and macromolecular scales, where the properties differ significantly from those at larger scale.



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- ❖ Generally **Nanotechnology** is dealing with functional systems based on the use of subunits, with structures of the **size 1-100 Nanometers** ,and involves developing **materials** or **devices** by controlling shape and size within that scale.
- ❖ Particles of materials at Nanoscale **change** their **properties** due to their **tiny** size and **large surface area to volume ratio** .



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- ❖ Nanomedicine is an **interdisciplinary** research field incorporating **biology**, **chemistry**, **engineering** and **medicine** with the intention to improve disease **prevention**, **diagnosis**, and **treatment**.
- ❖ Variety of Nanomaterials have been incorporated into **dermatological** products, **skin care**, **makeup**, **fabric** and **antibacterial** consumer products cleansers.



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- ❖ The advantages of using nanoparticles as drug carrier systems are: increasing drug half-life, reducing immunogenicity and improving bioavailability.



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أمثلة لتطبيقات النانو في المجال الطبي ومجالات أخرى:

Current Nanotechnology products

Skin care

Suanscreens, anti-wrinkle cream, camouflage, antibacterial cleansers, makeup, toothpaste, shampoo, Lipsticks, face powder, blush, eye shadow, perfume, aftershave lotion, appliances, self-cleaning surfaces.

Food

Ice cream, Nano-nutraceuticals

Household

Paints, antibacterial cleansers

Clothing

Sporting goods, shoe inserts

Automotive

Tires, engines

Military

Armor, camouflage, radioprotection

Electronics

OLED(organic light emitting diode) screens on digital cameras

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- ❖ "The **marriage** of Nanotechnology and stem cell will dramatically advance our ability to understand and control **stem cell-fate decision and develop novel stem cell technologies**, which will eventually lead to stem cell-based **therapeutics** for the prevention, diagnosis and treatment of human diseases" Yubing Xie
- ❖ Three main categories can be assigned to the use of Nanotechnology in stem cell research
 - 1- **tracking or labeling** (Qdots,SPIO/MRI)
 - 2- **delivery**
 - 3- **scaffold platforms** e.g (Nanofibers) .



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Nanoemulsion

- ❖ Nanoemulsions are promising **drug delivery systems**.
- ❖ Nanoemulsions have practical applications for **pharmaceutical, cosmetic** and chemical industry applications.
- ❖ **Antioxidants** Nanoemulsions form.



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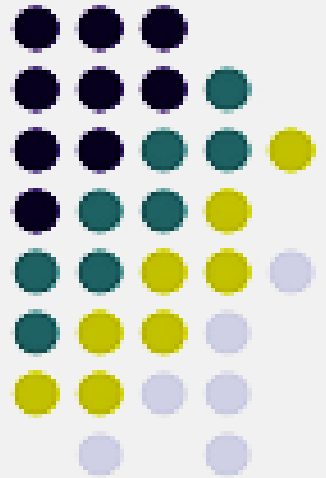
Nanoemulsion

- ❖ Nanoemulsions have been used as **carriers** to enhance skin **permeation** and improve the anti-inflammatory effect of **NSAIDs**.
- ❖ Nanoemulsions in **photodynamic** therapy.
- ❖ **Antimicrobial** Nanoemulsions.
- ❖ Nanoemulsions carrying **lipids**.



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❖ **Nanosilver** is a new generation of Nanoproduct in **biomedical** applications.



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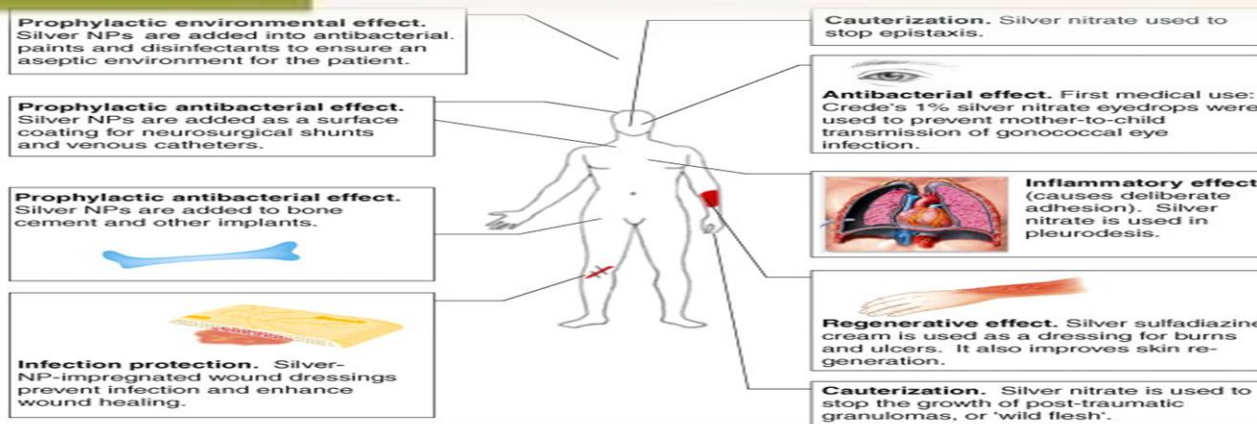
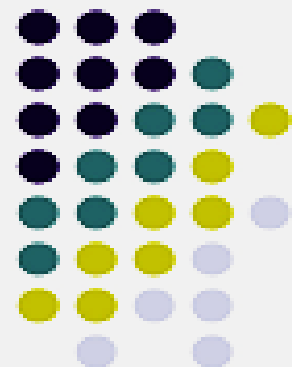
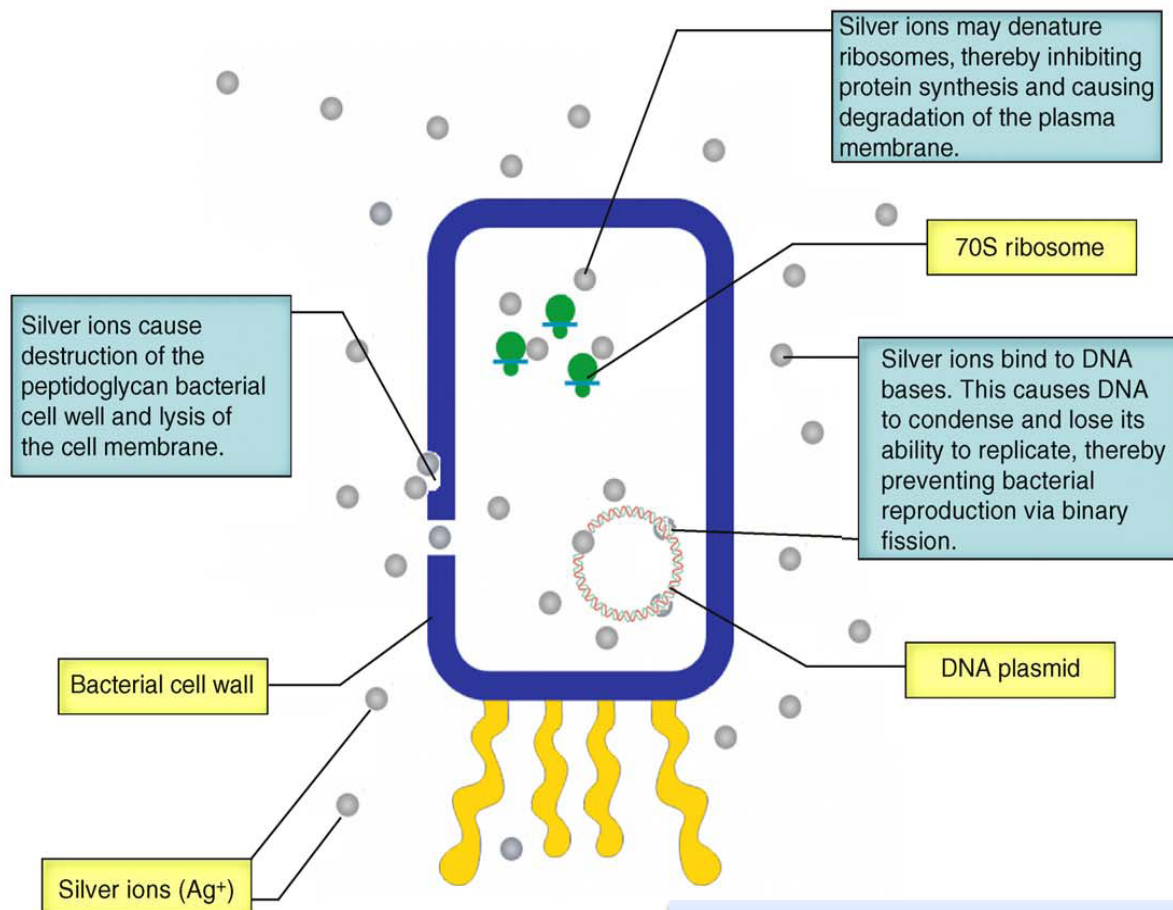


Figure 1. Uses of silver (right-hand side) and silver NPs (left-hand side) in medicine. Traditionally, silver nitrate is used in a number of clinical contexts, including stemming the flow of blood from nosebleeds, inducing pleurodesis when closing chest tube wounds and cauterization of granulomas. C.S.F. Crede's introduction of 1% silver nitrate eyedrops in 1881 prevented neonatal conjunctivitis and is still used clinically in developing countries. Silver sulfadiazine cream is used in the widespread treatment of burns [67], although argyria (discoloration of the skin) remains a prevalent side effect [8,49]. NS is emerging as a next-generation antibacterial agent [56], augmenting antibiotics and disinfectants for coating of medical devices. NS-based wound dressings are already commercially available (e.g. Acticoat™) and in current clinical use [53]. NS is used as an antibacterial additive or coating in a range of catheters [40–42] and in bone cement [46]. NS can also be used in hand gels [68] and paints [69] as a prolonged antibacterial disinfectant.

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Table 2. Compilation of recent studies on the antibacterial activity of NS

Microorganism tested	Findings	Refs.
E. coli, Vibrio cholera, P. aeruginosa, Salmonella typhi	Bactericidal effect of NS is size-dependent, with smaller NPs being more potent antibacterial agents. NP morphology was also important, with octahedral and decahedral particles having more highly reactive facets.	[22,76]
Enterococcus faecalis, S. aureus, E. coli, P. aeruginosa, S. epidermidis, Enterococcus faecium, Klebsiella pneumoniae	Different reducing saccharides were used to form NS of different sizes; smaller size NS exhibited more antibacterial activity against a range of different bacteria. Minimum inhibitory concentrations were 1.69–54.00 mg/ml.	[14]
E. coli, S. typhi, S. aureus	Antibacterial effect of NS was dose-dependent; NS more potent against Gram-negative (e.g. E. coli and S. typhi) than Gram-positive bacteria (e.g. S. aureus).	[23]
E. coli (4 strains), Bacillus subtilis (3 strains), S. aureus (3 strains)	Some strains of E. coli more resistant to bactericidal effects of NS than strains of S. aureus, contradicting earlier reports that Gram-negative are more sensitive to silver than Gram-positive bacteria; the authors attributed this to the fact that previous studies tested one strain of each bacterium rather than multiple strains.	[77]

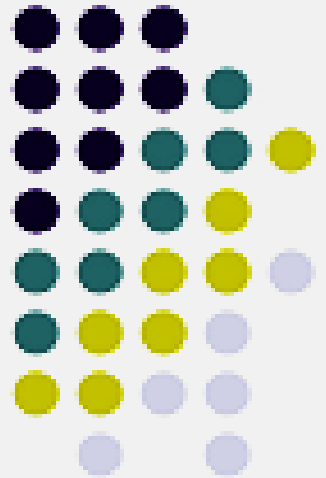
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- ❖ Expanding use of topical Nanosilver in Dermatology is due to its antimicrobial effect and ability to induce stem cell activation. It has been recently demonstrated that Nanosilver useful as anti-inflammatory effect .



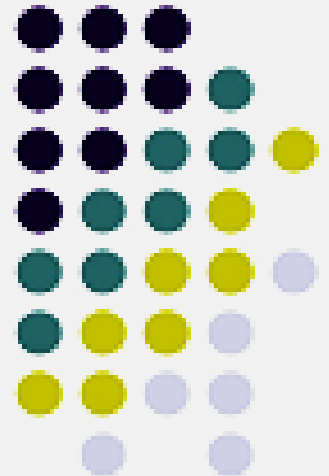
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❖ The topical use of **Nanosilver** in dermatology for treating skin infections, infected wounds, burns, diabetic foot and non-healing ulcers.



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- ❖ It has antibacterial, antifungal, antiviral (**In vitro**) and anti-inflammatory activity.



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❖ Nanosilver particles (NSPs) , are among the most attractive nanomaterial's, and have been widely used in a range of biomedical applications, including ,treatment, **drug delivery**, medical **device coating** , and for personal **health care**.



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- ❖ Antimicrobial efficacy of NSPs depends on their size and concentration .
- ❖ Normally, a high concentration leads to more effective antimicrobial activity, **while particles of small sizes can kill bacteria at a lower concentration.**



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Medical Nanosilver applications

- ❖ Research into the medical applications of Nanosilver has been extremely active, with a variety of **commercially** available products being used **clinically**.



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Product	company	Description	Clinical uses
Acticoat	Smith& Nephew	Nano crystalline silver	Dressing for range of wounds including burns a and ulcers, prevents bacterial infection and Improves wound healing.
Silver line	Spielberg	polyurethane ventricular Catheter impregnated With Nanosilver	Neurosurgical drain of CSF for hydrocephalus. also can be adapted for use as shunts. Antibacterial silver NP coating prevents catheter-associated infections.
SilvrSTAT®	ABL Medical	metallic silver nanoparticles (AG0) coated with tetrasilver tetroxide (Ag4O4), with total contained silver of just 0.0032%.	Dressing for range of wounds including burns a and ulcers, prevents bacterial infection and Improves wound healing.
SilvaSorb	Medline industries And acrymed	antibacterial product: hand gels, wound dressings, cavity filler	wound dressings and cavity filler prevent bacterial infection . hand gels used to disinfect skin in clinical And personal hygiene purposes

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Anti-inflammatory Nanosilver properties

Basic scientific research has been carried out to elucidate the mechanism underpinning the anti-inflammatory activity of Nanosilver observed clinically.



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- ❖ Anti-inflammatory properties of nanocrystalline silver were assessed by topically applying 1,2-dinitrochlorobenzene to induce contact dermatitis in swine. Nanocrystalline silver outperformed saline- and silver nitrate-soaked wound dressings for treatment of the resulting contact dermatitis.



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Emerging antiviral properties of Nanosilver:

- ❖ Novel antiviral properties of Nanosilver have been discovered in vitro, highlighting a possible therapeutic dimension to complement to its antibacterial activity. Early electron microscopy studies with NS and HIV-1 showed a size-dependent physical interaction, with NS of 1 nm in diameter able to directly bind to the virus.



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- ❖ It will be interesting to determine whether these preliminary in vitro studies can be successfully extrapolated to in vivo models of HIV infection, which could potentially yield new HIV therapeutics.



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PATIENT NUMBER: 1

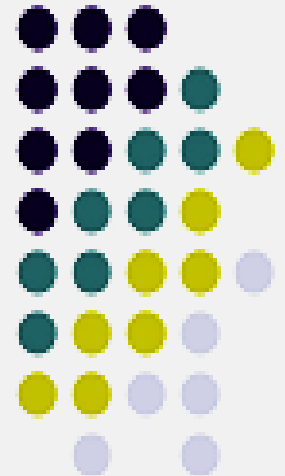
Diagnosis: 2nd degree thermal burn



Day one



Two Days after treatment with NANOSILVER



Courtesy of Skin and Allergy Centre

Nanoscience in Dermatology and Cosmetic Products

PATIENT NUMBER: 1

Diagnosis: 2nd degree thermal burn



Day one



Two Days after treatment with NANOSILVER



Courtesy of Skin and Allergy Centre

Nanoscience in Dermatology and Cosmetic Products

PATIENT NUMBER: 1

Diagnosis: 2nd degree thermal burn



1 week after treatment with NANOSILVER

Courtesy of Skin and Allergy Centre



Nanoscience in Dermatology and Cosmetic Products

PATIENT NUMBER: 2 **Diagnosis: Second Degree Burn**



Day One



Two days after Nanosilver treatment



Courtesy of Skin and Allergy Centre

Nanoscience in Dermatology and Cosmetic Products

PATIENT NUMBER: 2
Diagnosis: Second Degree Burn

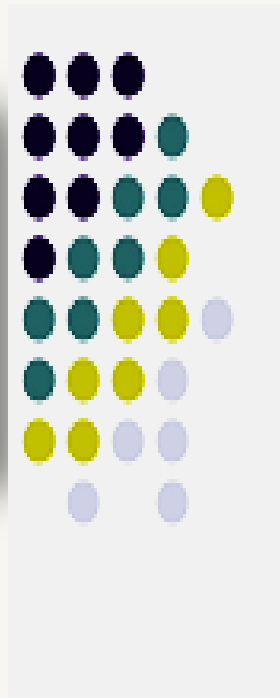


Four days after Nanosilver treatment



One week after Nanosilver treatment

Courtesy of Skin and Allergy Centre



Nanoscience in Dermatology and Cosmetic Products

PATIENT NUMBER: 3

DIAGNOSIS: Healing 2nd degree burn, with contact reaction to Mebo Scar ointment



After Day 10



One week after Nanosilver treatment

Courtesy of Skin and Allergy Centre



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Efficacy of a New Topical Nano-hyaluronic Acid in Humans.

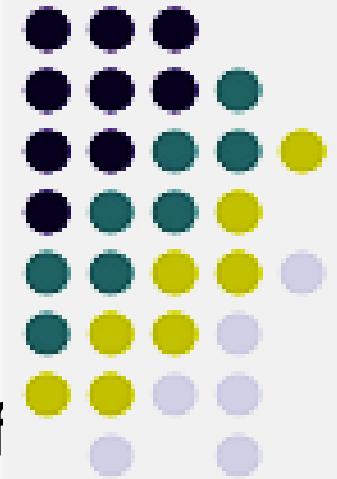
The use of topical Nano- hyaluronic acid in Humans.



Nanoscience in Dermatology and Cosmetic Products

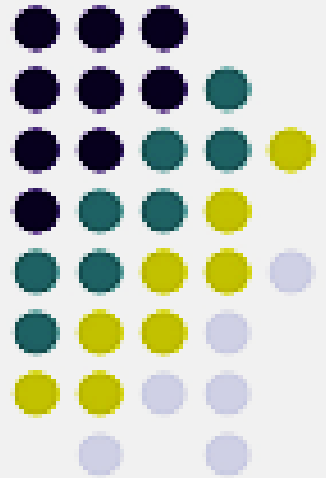
Nano-hyaluronic Acid in Humans

- ❖ a statistically significant moisturizing effect was observed with Nano-hyaluronic acid in the full product range—cream, serum, and lotion. After 2,4, and 8 weeks of treatment, the skin was significantly more hydrated than the untreated skin.



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- ❖ Measurement of skin roughness showed a significantly finer skin structure (Ra) after two weeks of treatment with the full product range.



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- ❖ improvement of skin elasticity (r7) was measured in comparison to untreated skin and demonstrated a significant improvement after two weeks of treatment and continued throughout the study.



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Figure 1 Baseline photo—before treatment



Figure 2 .Day 57 photo—after Nano-hyaluronic acid treatment



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[Pharm Dev Technol.](#) 2015 May 29:1-9. [Epub ahead of print]

- ❖ A novel nanogel formulation of methotrexate for topical treatment of psoriasis: optimization, in vitro and in vivo evaluation. [Avasatthi V₁](#), [Pawar H](#), [Dora CP](#), [Bansod P](#), [Gill MS](#), [Suresh S](#).
- ❖ The objective was to develop a nanogel composed of methotrexate (MTX)-loaded nanostructured lipid carrier (MTX-NLC) and to evaluate its potential in imiquimod-induced psoriasis model to ameliorate symptoms of psoriasis.
- ❖ **CONCLUSION:** The developed MTX-NLC gel formulation can be a promising alternative to existing MTX formulation in treating psoriasis.



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- ❖ [Mol Pharm.](#) 2014 Jul 7;11(7):2213-23. doi: 10.1021/mp400269z. Epub 2013 Nov 19.

Methotrexate-loaded PEGylated chitosan nanoparticles: synthesis, characterization, and in vitro and in vivo antitumoral activity.

[Chen J](#)¹, [Huang L](#), [Lai H](#), [Lu C](#), [Fang M](#), [Zhang Q](#), [Luo X](#).

- ❖ These results suggest that MTX-mPEG-CS NPs could be a promising targeting anticancer chemotherapeutic agent, especially for cervical carcinoma.

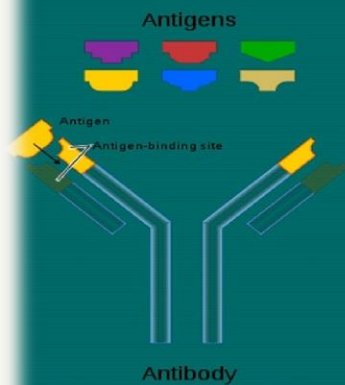


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NANO GOLD AND CANCER TREATMENT

UNIVERSITY
OF GUELPH

CHANGING LIVES
IMPROVING LIFE



<http://en.wikipedia.org/wiki/Antibody>

Researchers are using nano-sized particles of gold to treat cancer.

Many tumour cells have unique protein molecules on their surface. Those proteins are not usually in the body so they are called Antigens. Antibodies are created within the body as a defense mechanism against antigens. Antibodies are specific to the antigens that they bind to just like puzzle pieces. Nano gold particles can be attached to the antibodies specific to the tumour cells.

The tumour cells are easily located due to the gold particles. Once the tumour is located, it can be irradiated with a laser. The energy from the laser is converted to heat by the gold particles. The tumour cells are selectively burnt away due to the heat from the gold nanoparticles while the surrounding tissue has little damage.

This type of treatment should prove to be less invasive with fewer side effects and shorter recovery time.

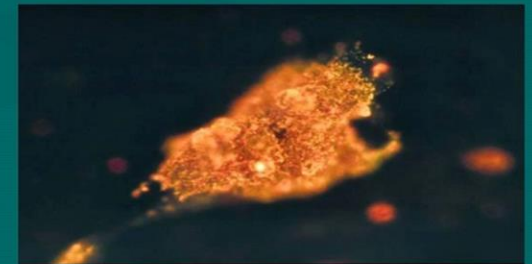


Image of a cancer cell illuminated by gold nanorods bound to anti-EGFR. Image courtesy of Mostafa El-Sayed, Georgia Tech.
http://nano.cancer.gov/news_center/nanotech_news_2006-03-27b.asp

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A Clinical Trial of Topical Bleaching Treatment with Nanoscale Tretinoin Particles and Hydroquinone for Hyperpigmented Skin Lesions

KATSUJIRO SATO, MD, *DAISUKE MATSUMOTO, MD,* FUMIKO IIZUKA,MD,* EMIKO AIBA-KOJIMA ,MD,* CHIAKI MACHINO,MD.* HIROTAKA SUGA,MD,* ASMI WATANABE-ONO,MD,* KETTA INOUE,MD,KOICHI GONDA, MD,* AND KOTARO YOSHIMURA,MD*



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Figure 2: Case 1: A 40-year-old woman with a solar lentigine and melasma on her right cheek, first shown before treatment (A). The solar lentigine was first treated with a Q-switched ruby laser, but 4 weeks later PIH appeared at the original position (B). Bleaching treatment with 0.1% nano-atRA gel and HQ-LA ointment was performed for 4 weeks; the patient is shown at 2 weeks (C) and at 4 weeks (D). This was followed by healing treatment with HQ-AA ointment alone for 4 weeks. Only minimal erythema appeared during the bleaching phase. PIH was completely eliminated and the melasma was also apparently improved at 8

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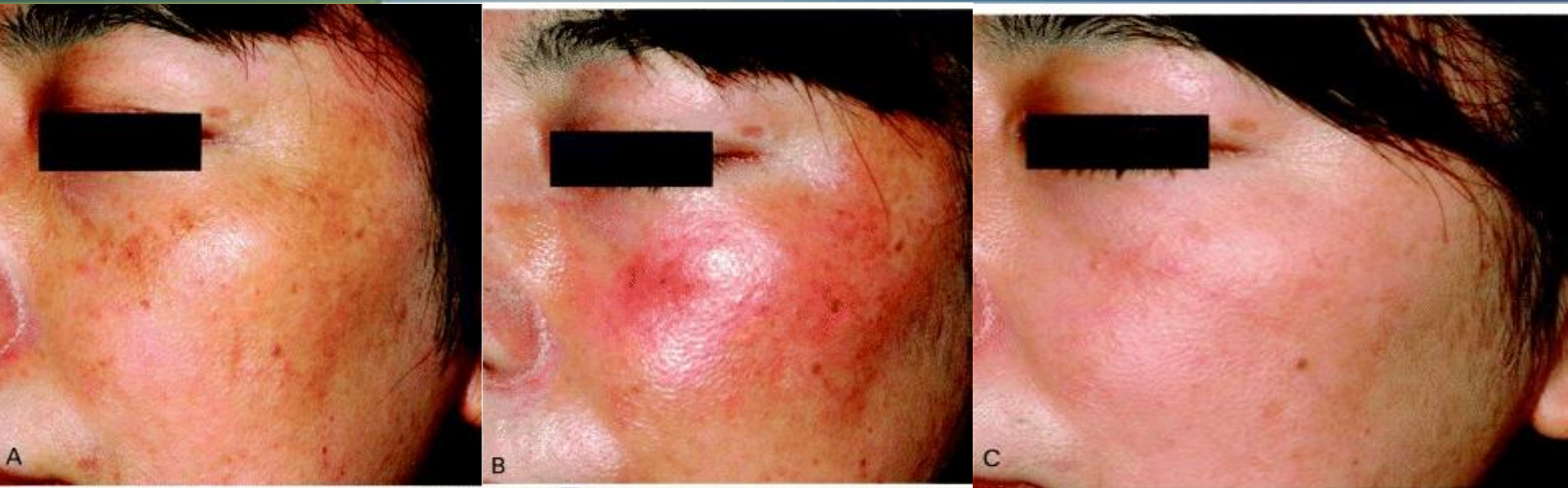


Figure 3: Case 2: A 38-year-old woman with melasma on both cheeks is shown before the treatment (A). Bleaching with 0.1% nano-atRA gel and HQ-LA ointment was performed for 12 weeks, followed by application of HQ-AA ointment alone for 4 weeks. Mild erythema appeared during the bleaching phase, shown at 4 weeks (B). The melasma was almost cleared at 16 weeks (C).

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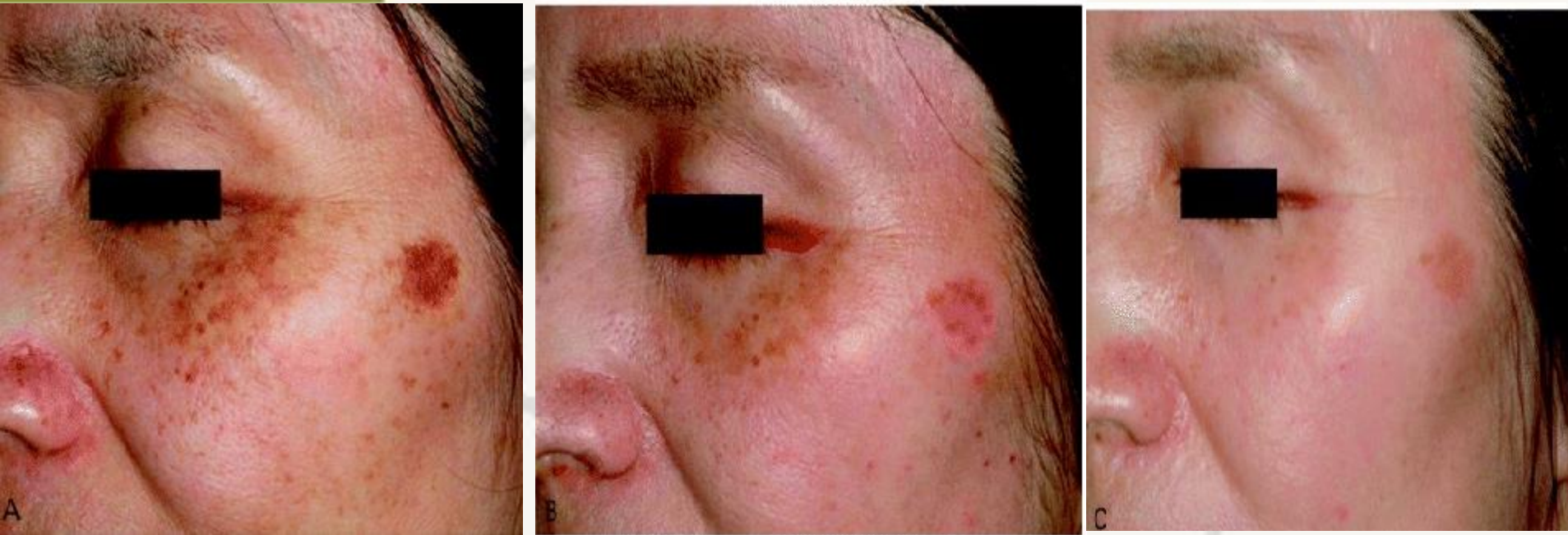
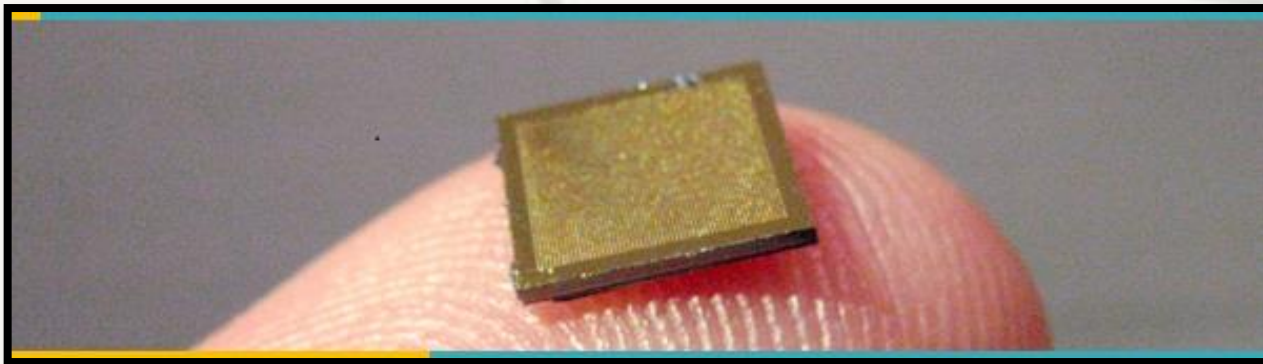


Figure 4: Case 3: A 53-year-old woman with a solar lentigine and melasma on her left cheek before the treatment (A). 0.1% nano-atRA gel was used together with HQ-LA ointment in bleaching phase for 12 weeks, and HQ-AA ointment was applied alone in the healing phase for 9 weeks. Mild erythema was seen during the bleaching phase, shown at 4 weeks (B). The melasma almost disappeared, whereas the solar lentigine became lighter, as seen at 21

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- the university of Queensland researchers develop a dissolvable needle-free Nanopatch for vaccine delivery.



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- The found the Nanopatch – a needle-free, pain-free method of vaccine delivery – is now dissolvable, eliminating the possibility of needle-stick injury and zero opportunity for contamination



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Conclusion

- ❖ Young Generation in our countries should learn about Nanotechnology in early school years.
- ❖ Nanodermatology is one of most active research areas.
- ❖ Nanoengineered dermatological Medications are used in the treatment of skin diseases, Such as acne vulgaris eczema , psoriasis , melasma ,skin cancer , anti-tumor skin infections ,diabetic foot Non healing ulcers and burns.



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Conclusion

❖ Despite the evident and appealing qualities of Nano-engineered products, and the numerous Nanomaterials manufactured over the past few years, very little is known about the safety aspects of such materials, thus caution and responsibility of all professionals handling Nanotechnology.



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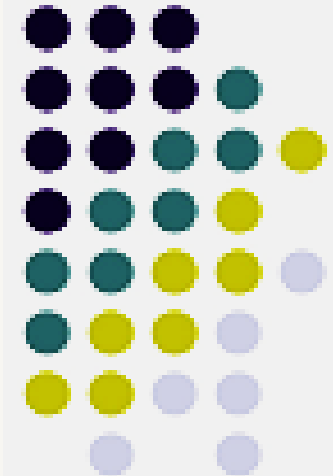
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[8?_returnURL=http%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS0](http://www.cell.com/trends/biotechnology/abstract/S0167-7799(10)00122-8?_returnURL=http%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS0)



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10- A novel nanogel formulation of methotrexate for topical treatment of psoriasis: optimization, in vitro and in vivo evaluation.

[Avasatthi V1](#), [Pawar H](#), [Dora CP](#), [Bansod P](#), [Gill MS](#), [Suresh S](#). [Pharm Dev Technol](#). 2015 May 29:1-9.

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12- the university of Queensland researchers , Professor Kendall or Penny Robinson

<http://www.aibn.uq.edu.au/nanopatch-dissolvable>

