C0r0n@ 2 Inspect

Review and analysis of scientific articles related to experimental techniques and methods used in vaccines against c0r0n@v|rus, evidence, damage, hypotheses, opinions and challenges.

Friday, August 13, 2021

Clothes with graphene oxide

Reference

Zhao, J .; Deng, B .; Lv, M .; Li, J .; Zhang, Y .; Jiang, H .; Fan, C. (2013). Graphene Oxide-Based Antibacterial Cotton Fabrics. Advanced Healthcare Materials, 2 (9), pp. 1259-1266. https://doi.org/10.1002/adhm.201200437

Facts

1. The article by (Zhao, J .; Deng, B .; Lv, M .; Li, J .; Zhang, Y .; Jiang, H .; Fan, C. 2013) develops a methodology for " *fixing GO sheets on cotton fabrics, which have a strong antibacterial property and great durability when washed* ". The graphene oxide sheets are woven into the cotton fibers, remaining fixed to the fabric, see figure 1.

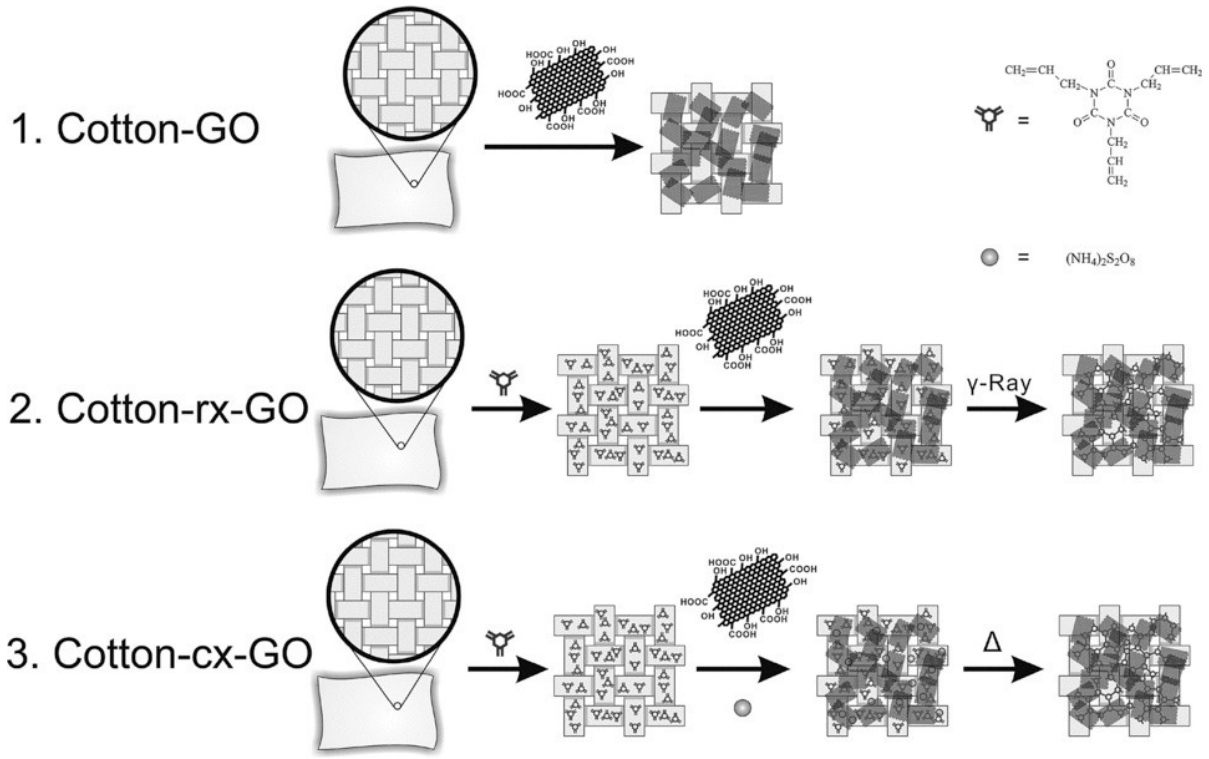

Fig. 1. Composition diagrams of cotton fabric with graphene oxide. (Zhao, J .; Deng, B .; Lv, M .; Li, J .; Zhang, Y .; Jiang, H .; Fan, C. 2013)

4. They also state that " *GO-based antibacterial cotton fabrics are prepared in three ways: direct adsorption, radiation-induced crosslinking, and chemical crosslinking ... most significantly these fabrics can still kill> 90% bacteria even after of washing 100 times ... animal tests show that GO-modified cotton fabrics do not cause irritation to rabbit skin* . " However, such benefits of GO graphene oxide are in complete contradiction with the cytotoxicity studies of GBM graphene-based materials in contact with the skin (Pelin, M.; Fusco, L.; León, V.; Martín, C.; Criado, A.; Sosa, S.; Prato, M. 2017). In fact, the in-vitro study skin toxicity reached worrying results with compounds graphene oxide on after 72 hours, inducing mitochondrial and plasma membrane affecting cell viability damage, concluding that " *the high concentrations and prolonged exposure times to FLG and GO could affect mitochondrial activity associated with plasma membrane damage, suggesting cytotoxic effects* . "It is also stated that" *In contrast to the absence of antiproliferative properties, the effects of FLG and GOs on HaCaT cells appear to involve significant damage to plasma membrane levels, as assessed by cell uptake of propidium iodide* . "

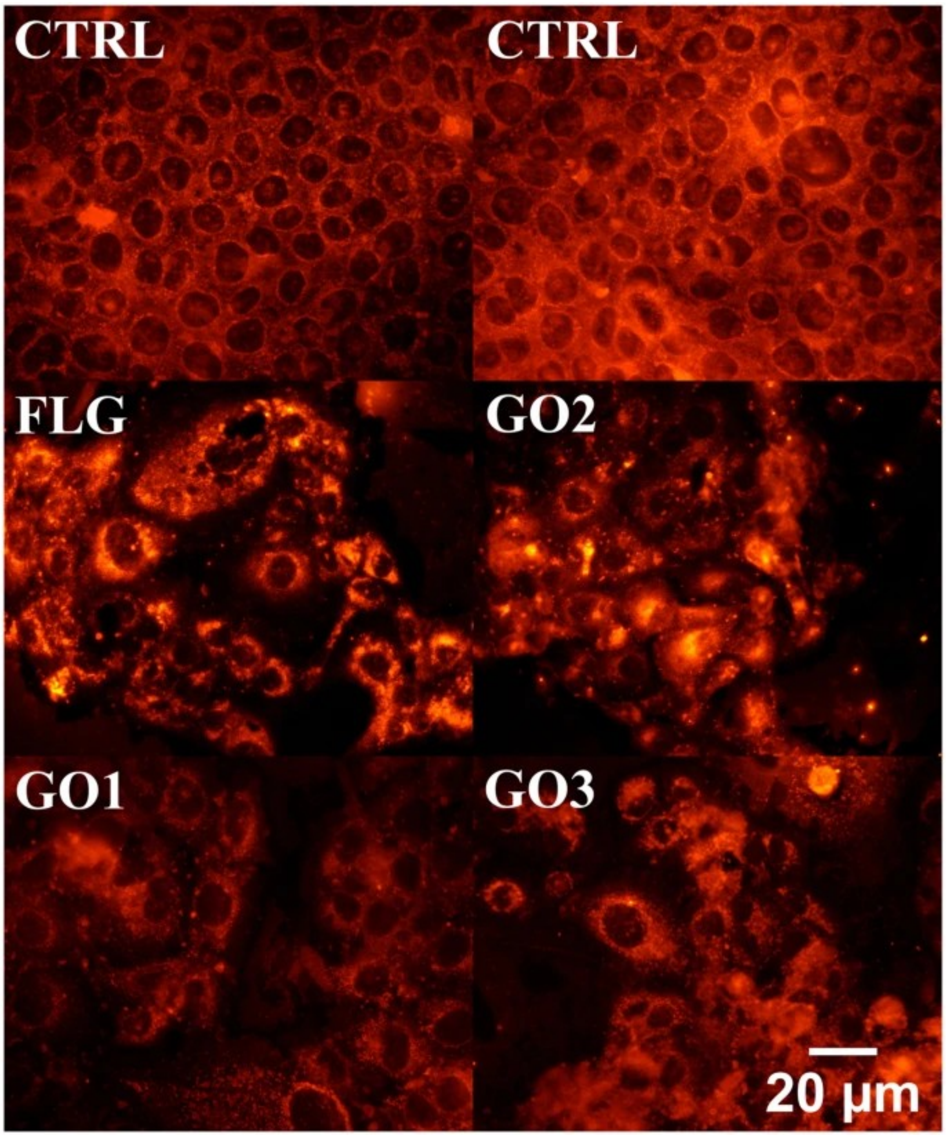

Fig. 2. Damage to the plasma membrane after 72 hours, caused by materials derived from graphene oxide (Pelin, M .; Fusco, L .; León, V .; Martín, C .; Criado, A .; Sosa, S .; Prato, M. 2017)

3. Another study, even more forceful in its conclusions, corroborates the detrimental effects of graphene oxide on the skin (Liao, KH; Lin, YS; Macosko, CW; Haynes, CL 2011). The researchers determined " *the cytotoxicity of graphene oxide and graphene sheets by measuring mitochondrial activity in human skin fibroblasts ... using the water-soluble tetrazolium salt (WST-8), trypan blue exclusion, and the Reactive oxygen species (ROS) reveal that compacted graphene sheets are more damaging to mammalian fibroblasts than less dense graphene oxide* . " To these results, the researchers add other conclusions. They observed that "*At the smallest size, graphene oxide showed the highest hemolytic activity, while the aggregated graphene sheets exhibited the lowest hemolytic activity. The coating of graphene oxide with chitosan almost eliminated the hemolytic activity* . "Although chitosan is not the subject of this post, it is worth noting that it has a very relevant role in the new packaging films for food products, hydrogels and dressings for the wound healing, see entry on food packaging graphene oxide . These studies contradict clear and compelling evidence that the advantages and benefits that state much research on graphene oxide are false.

Other studies

1. The large amount of research on textiles and graphene oxide to create all kinds of clothing is striking. For example (Cai, G.; Xu, Z.; Yang, M.; Tang, B.; Wang, X. 2017) develops a method of functionalizing cotton fabrics with graphene oxide, through thermal reduction. In their study they corroborate the " *good electrical conductivity* ", the permanence of graphene oxide in the tissues without it " *affecting the electrical conductivity* ", providing " *hydrophobic and UV blocking properties* ". These details are very relevant since the electromagnetic absorption properties of graphene oxide . This would convert clothing woven from cotton (although it could be other materials) and graphene oxide into a receiving antenna, which would amplify the signal emitted from 5G devices. Also striking is the blocking of UV rays, since graphene oxide can degrade by exposure to ultraviolet rays as demonstrated in research by (Bai, H.; Jiang, W.; Kotchey, GP; Saidi, WA; Bythell, BJ; Jarvis, JM ; Star, A. 2014). In their article Bai, et.al. Explain that the Fenton reaction (an oxidation process that generates highly reactive hydroxyl radicals) affects the stability of graphene oxide, as well as the introduction of ultraviolet radiation, which accelerates this process.This is clarified with the following statement " *It is widely accepted that the oxidative species of the Fenton mechanism consist of radicals that include the highly reactive hydroxyl radical, and the introduction of ultraviolet (UV) irradiation to the system accelerates the production of this radical species* . "In the case of (Gao, Y .; Ren, X .; Zhang, X .; Chen, C. 2019) in addition to confirming the interaction of ultraviolet light in the degradation of graphene oxide, they make some worrying claims, for example " *Currently, there is little comparative data on colloidal stability and toxicity of graphene oxide (GO) transformed with ultraviolet light (UV) and visible light (VL).* This means that the authors openly acknowledge that there is a lack of research on the detrimental effects of graphene oxide as early as 2019, when graphene oxide is being used extensively throughout the industrial and productive ecosystem, see all available patents. on graphene oxide (more than 5,000 patents whose title includes the keyword graphene oxide, more than 34,000 patents contain the keyword in their abstract or claims and almost 50,000 patents that contain the keyword in some field of its description). On the other hand, they correlate graphene oxide to the UV ultraviolet exposure variable, showing that the molecular structure degrades, producing graphene quantum dots, also called "Quantum dots", with which memristors curiously form . The authors conclude that " *the exposure of graphene oxide GO to*

the UV ultraviolet exposure variable, showing that the molecular structure degrades, producing graphene quantum dots, also called "Quantum dots", with which memristors curiously form . *The authors conclude that " the exposure of graphene oxide GO to sunlight will enhance its physicochemical transformations. This is similar to the phenomenon of photoreaction of nanomaterials dissolved in fresh water, their transformation and degradation induced by UV / VL (Ultraviolet / Visible Light).* ". They also add that " *both UV and VL irradiation can make GO graphene oxide much more stable and mobile in city water and natural surface water than expected ... When UV radiation is used to degrade GO during treating water, irradiation time is a key operational parameter ... " . This is very important, it could be a way to eliminate or combat the effects of graphene oxide in the human body. However, " the Toxic effects of UV / VL transformed GO samples are measured by inactivation of E.Coli and S.Aureus ... UV exposure has a great influence on the toxic effect of GO*". This means that in the process of degradation of graphene oxide quantum dots, toxicity problems could be caused, both for animals and for the environment.

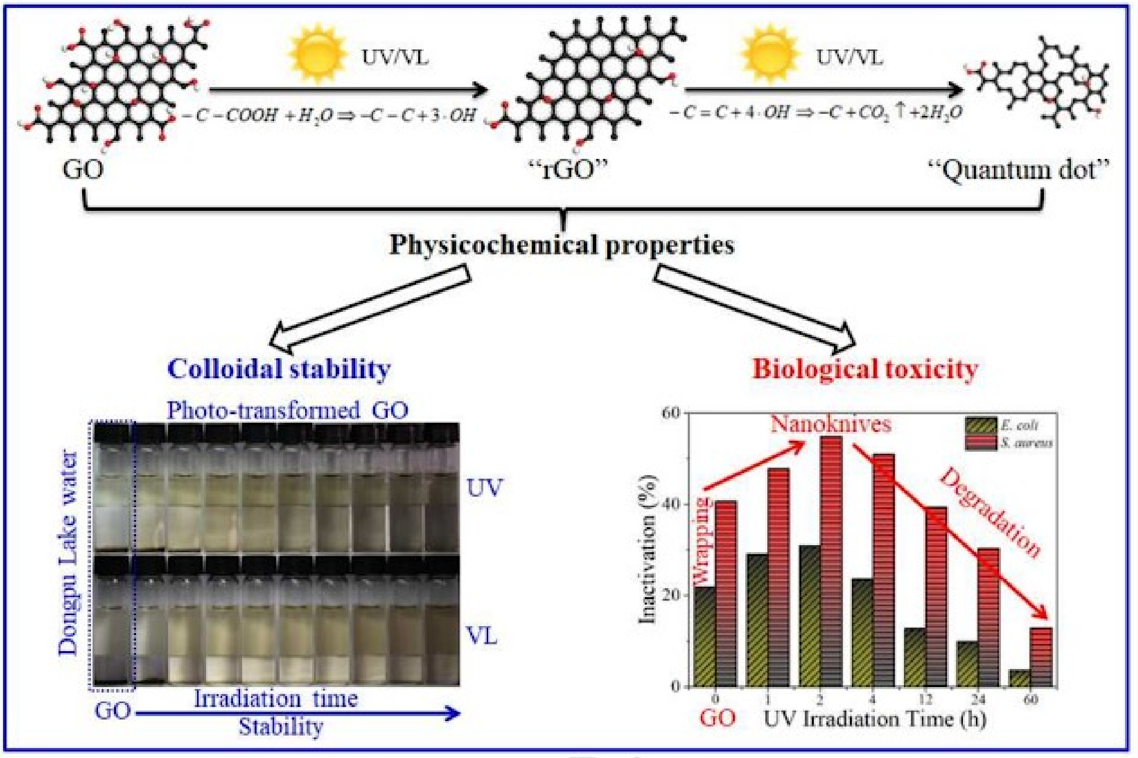

Fig. 3. Degradation of graphene oxide with ultraviolet light. (Gao, Y.; Ren, X.; Zhang, X.; Chen, C. 2019)

In this regard, the scientific literature has been reviewed and it has been found that (Wang, T .; Zhu, S .; Jiang, X. 2015) analyze the toxicity of graphene quantum dots and add the following keys: 1) " *The Graphene quantum dots (GQD) generate intrinsic fluorescence and improve the aqueous stability of graphene oxide (GO) while maintaining broad chemical adaptability and high adsorption capacity* . " This statement is important because it means that the adsorbent capacity is increased and with it the capacity to immobilize enzymes of the human body . 2) " *We found that GQD (Graphene Quantum Dots) did not show obvious influence in the mice due to its small size, while GO appeared toxic, even causing the death of the mice due to the aggregation of GO within the mice. In summary, GQD has no obvious toxicity in vitro and in vivo, even in multi-dose situations* . "This suggests that the hypothetical toxicity of GQDs (Graphene Quantum Dots) is reduced by exposure to sunlight or ultraviolet light, in comparison with GO graphene oxide without degrading. 3) Other authors such as (Chong, Y .; Ma, Y .; Shen, H .; Tu, X .; Zhou, X .; Xu, J .; Zhang, Z. 2014) state that " *A detailed analysis of the infrared spectra revealed that GO adsorption destroys the integrity of the cell membrane by removing the lipid bilayer, resulting in hemolysis and aberrant forms. In contrast, GQDs only alter lipid structure and conformation, resulting in only aberrant cells*. The researchers therefore confirm that the toxic effects of graphene quantum dots are slightly lower than the GO graphene oxide itself from which they originate. However, we must not lose sight of the fact that the GQD tests on red blood cells caused aberrant cells. This detail could explain blood circulation problems, heart inflammation, pericarditis, myocarditis and even degenerative neuromuscular diseases. In fact, the study of (Qu, G .; Wang, X .; Wang, Z .; Liu, S .; Jiang, G. 2013) state that in their tests " *QDs (quantum dots) caused great damage to macrophages through the intracellular accumulation of QD together with the generation of reactive ROS oxygen species, in particular for QDs coated with PEG-NH2* ". This indicates that the toxicity of graphene oxide quantum dots (which is degraded graphene oxide) also presents toxicity that causes the release of free radicals in (ROS Reactive oxygen species) and damage to macrophages (cells responsible for destroying antigens in our body), especially when the quantum dots are coated with PEG-NH2, which is a polyethylene glycol compound that would hypothetically protect the body against graphene toxicity; by the way, studied in the entry on the interaction of graphene oxide in brain cells . Returning to the analysis of the study by (Cai, G .; Xu, Z .; Yang, M .; Tang, B .; Wang, X. 2017) on functionalization of cotton fabrics with graphene oxide and its anti-UV properties, it can be deduced that its objective is to preserve the integrity of graphene oxide in textile products, to avoid its degradation and conversion to graphene quantum dots.

2. Other investigations related to cotton and graphene oxide fabrics appear to demonstrate their thermal stability. According to (Krishnamoorthy, K .; Navaneethaiyer, U .; Mohan, R .; Lee, J .; Kim, SJ 2012) " *Thermogravimetric analysis (TGA) showed that GO-loaded cotton fabrics have improved thermal stability compared with the naked cotton fabrics* . " According to (Rani, KV; Sarma, B .; Sarma, A. 2018) graphene oxide, not only would serve to interweave with cotton, it could also cover it completely, through the immersion process, obtaining improved electrically conductive properties. Other similar investigations are those of (Ren, J .; Wang, C .; Zhang, X .; Carey, T .; Chen, K .; Yin, Y .; Torrisi, F. 2017 | Sahito, IA; Sun, KC ; Arbab, AA; Qadir, MB; Jeong, SH 2015 | Shateri-Khalilabad, M .; Yazdanshenas, ME 2013) that analyze the conductive properties in cotton fabrics and flexible, hot-pressed graphene oxide, with loaded graphene oxide negatively.
3. Graphene oxide has also been introduced into polyester fabrics (Cao, J .; Guan, X .; Wang, Y .; Xu, L. 2021) through the printing and hot pressing technique. In the same way as in other studies (Cai, G .; Xu, Z .; Yang, M .; Tang, B .; Wang, X. 2017), the fabric presents electrical conductivity, resistance to friction and washability. Graphene oxide can also be introduced through dyes, as shown (Fan, L .; Tan, Y .; Amesimeku, J .; Yin, Y .; Wang, C. 2020 | Fang, J .; Gao, X .; Cai, X .; Lou, T. 2020 | Fugetsu, B .; Sano, E .; Yu, H .; Mori, K .; Tanaka, T. 2010), improving electrostatic properties and electrical conductivity. In this sense, the work of (Kowalczyk, D .; Fortuniak, W .; Mizerska, U .; Kaminska, I .; Makowski, T .; Brzezinski, S .; Piorkowska, E. 2017) in which they verify that fabrics coated with xerogel 0.5-1.5% by weight in reduced graphene oxide rGO, improves their antistatic properties and their surface and volumetric resistance. Xerogels are a type of gels with great porosity, which provide the treated fabric with the ability to repel water and electrical conductivity.

4. Other research addresses the development and manufacture of fabrics for protection against electromagnetic interference, for which graphene oxide and silver are used (Ghosh, S .; Ganguly, S .; Das, P .; Das, TK; Bose, M. ; Singha, NK; Das, NC 2019), resulting in textile products that resist 27.36 dB in the X band (8.2-12.4 GHz). In addition to protection against electromagnetic interference, there is graphene oxide fabric oriented to "high microwave absorption", as stated (Gupta, S .; Chang, C .; Anbalagan, AK; Lee, CH; Tai, NH 2020) in his study. Curiously, this fabric is also designed to operate on the X band (8.2-12.4 GHz).
5. Polypropylene non-woven fabrics can also be developed for the development of graphene-based wearable sensors, resulting in smart fabrics. This is the approach of (Hasan, MM; Zhu, F .; Ahmed, A .; Khoso, NA; Deb, H .; Yuchao, L .; Yu, B. 2019). The applications cited by the authors include " *filtration membranes used in clothing and potential industrial use due to their increased breathability, durability, absorbency, and filtration properties. Nonwoven PP (polypropylene) fabrics are widely used to develop articles portable as garments* ". In this work, it is possible to develop a membrane based on graphene oxide and polypropylene fabric that is capable of acting as a pressure sensor. Previously (Du, D .; Li, P .; Ouyang, J. 2016) also developed graphene-coated fabrics to develop sensors capable of picking up the pulse and respiration. In fact, these studies open the possibility to the development of textile-based portable electronics (Khan, J .; Mariatti, M. 2021) that are flexible and overcome the limitations of rigid electronics. However, the authors are not aware of or do not wish to transcend the dangerousness of graphene oxide, which is why it follows from their statements " *Graphene is the main candidate among other forms of carbon (to develop electronic textiles) due to its properties exceptional and non-toxic.*". For this, it seems essential that the textile fabric has thermal conductivity and electromagnetic absorption capabilities, as can be seen from its tests." *Polyester modified with sodium hydroxide presented the best result with an improvement of 30% in absorption and 15% % in thermal conductivity compared to untreated polyester* . "Another example of smart garments with graphene oxide are sports bras (Shathi, MA; Chen, M .; Khoso, NA; Rahman, MT; Bhattacharjee, B. 2020), developed with the graphene oxide dyeing technique, which " *improved electrical conductivity and tensile strength, stability against washing, low impedance ", concluding that "the pad dry-curing method can potentially be used for the development of graphene-coated portable electronic textiles for biomedical and health-monitoring devices* . "
6. Another type of fabric in which graphene oxide is introduced is " *polyethylene terephthalate* ", commonly used for the manufacture of garments and in beverage containers (Liu, X .; Qin, Z .; Dou, Z .; Liu , N .; Chen, L .; Zhu, M. 2014), in which case the structural stability of the tissue and high electrical conductivity are also sought.
7. Screen printing has also been the object of study to apply graphene oxide, as it is referred to in the work of (Qu, J.; He, N.; Patil, SV; Wang, Y.; Banerjee, D.; Gao, W. 2019). In this case, the authors summarize that " *Graphene-based e-textiles have attracted great interest due to their promising applications in sensors, protection and wearable electronic devices. Here, we report a scalable screen printing process along with continuous treatment. Dry cure for the creation of durable graphene oxide (GO) patterns on viscose nonwovens at a controllable depth of penetration* . "

Hypothesis

1. Clothing woven with GO graphene oxide, cotton and other materials could be used to amplify and improve the reception of 5G electromagnetic waves, facilitating electrical conductivity and favoring neuromodulation processes in those inoculated with c0r0n @ v | rus vaccines .
2. It seems to be demonstrated that graphene oxide degrades when it comes into contact with ultraviolet light, as indicated (Gao, Y.; Ren, X.; Zhang, X.; Chen, C. 2019), generating remains of the process of oxidation in the form of graphene quantum dots. This would explain some contradictions in the recommendations not to sunbathe after the c0r0n @ v | rus vaccine , prior to saying that it was possible to sunbathe , in some media. In any case, the danger of graphene oxide and its derivatives, including graphene quantum dots, for human health seems proven and proven.
3. Since graphene oxide is degraded by sunlight or ultraviolet irradiation, many researchers developed methods to incorporate protection of textiles against these agents, see (Miao, GY; Zhang, ZZ 2017 | Tang, X .; Tian Tian , M .; Qu, L .; Zhu, S .; Guo, X .; Han, G .; Xu, X. 2015 | Tian, M .; Hu, X .; Qu, L .; Du , M .; Zhu, S .; Sun, Y .; Han, G. 2016). As graphene oxide does not degrade in the fabric, it maintains its properties intact to absorb electromagnetic radiation.
4. It seems logical that given the suspicion of the presence of graphene oxide in textile products, an exhaustive analysis of all types of garments and fabrics available on the market will be carried out, in order to avoid this possible source of contamination / poisoning by graphene oxide, Given its transdermal properties, see entry on food packaging, where this property is explained.

Bibliography

1. Bai, H .; Jiang, W .; Kotchey, GP; Saidi, WA; Bythell, BJ; Jarvis, JM; Star, A. (2014). Insight into the Mechanism of Graphene Oxide Degradation via the Photo-Fenton Reaction. The Journal of Physical Chemistry C, 118 (19), pp. 10519-10529. https://doi.org/10.1021/jp503413s
2. Cai, G .; Xu, Z .; Yang, M .; Tang, B .; Wang, X. (2017). Functionalization of cotton fabrics through thermal reduction of graphene oxide. Applied surface science, 393, pp. 441-448. https://doi.org/10.1016/j.apsusc.2016.10.046
3. Cao, J .; Guan, X .; Wang, Y .; Xu, L. (2021). Highly conductive polyester fabrics manufactured by graphene oxide printing and hot-pressing. Surface Innovations, 40, 1-8. https://doi.org/10.1680/jsuin.21.00005a
4. Chong, Y .; May.; Shen, H .; You, X .; Zhou, X .; Xu, J .; Zhang, Z. (2014). The in vitro and in vivo toxicity of graphene quantum dots. Biomaterials, 35 (19), pp. 5041-5048. https://doi.org/10.1016/j.biomaterials.2014.03.021
5. Du, D .; Li, P .; Ouyang, J. (2016). Graphene coated nonwoven fabrics as wearable sensors. Journal of Materials Chemistry C, 4 (15), pp. 3224-3230. https://doi.org/10.1039/C6TC00350H
6. Fan, L .; Tan, Y .; Amesimeku, J .; Yin, Y .; Wang, C. (2020). A novel functional disperse dye doped with graphene oxide for improving antistatic properties of polyester fabric using one-bath dyeing method. Textile Research Journal, 90 (5-6), pp. 655-665. https://doi.org/10.1177%2F0040517519877464

7. Fang, J .; Gao, X .; Cai, X .; Lou, T. (2020). UV protection of silk fabric modified with reduced graphene oxide. China Dyeing & Finishing. https://en.cnki.com.cn/Article_en/CJFDTotal-YIRA202009011.htm
8. Fugetsu, B .; Sano, E .; Yu, H .; Mori, K .; Tanaka, T. (2010). Graphene oxide as dyestuffs for the creation of electrically conductive fabrics. Carbon, 48 (12), pp. 3340-3345. https://doi.org/10.1016/j.carbon.2010.05.016
9. Gao, Y .; Ren, X .; Zhang, X .; Chen, C. (2019). Environmental fate and risk of ultraviolet-and visible-light-transformed graphene oxide: A comparative study. Environmental Pollution, 251, pp. 821-829. https://doi.org/10.1016/j.envpol.2019.05.010
10. Ghosh, S .; Ganguly, S .; Das, P .; Das, TK; Bose, M .; Singha, NK; Das, NC (2019). Fabrication of Reduced Graphene Oxide / Silver Nanoparticles Decorated Conductive Cotton Fabric for High Performing Electromagnetic Interference Shielding and Antibacterial Application. Fibers and Polymers, 20 (6), pp. 1161-1171. https://doi.org/10.1007/s12221-019-1001-7
11. Gupta, S .; Chang, C .; Anbalagan, AK; Lee, CH; Tai, NH (2020). Reduced graphene oxide / zinc oxide coated wearable electrically conductive cotton textile for high microwave absorption. Composites Science and Technology, 188, 107994. https://doi.org/10.1016/j.compscitech.2020.107994
12. Hasan, MM; Zhu, F .; Ahmed, A .; Khoso, NA; Deb, H .; Yuchao, L .; Yu, B. (2019). Functionalization of polypropylene nonwoven fabrics using cold plasma (O2) for developing graphene-based wearable sensors. Sensors and Actuators A: Physical, 300, 111637. https://doi.org/10.1016/j.sna.2019.111637
13. Khan, J .; Mariatti, M. (2021). The Influence of Substrate Functionalization for Enhancing the Interfacial Bonding between Graphene Oxide and Nonwoven Polyester. Fibers and Polymers, pp. 1-11. https://doi.org/10.1007/s12221-021-1386-y
14. Kowalczyk, D .; Fortuniak, W .; Mizerska, U .; Kaminska, I .; Makowski, T .; Brzezinski, S .; Piorkowska, E. (2017). Modification of cotton fabric with graphene and reduced graphene oxide using sol – gel method. Cellulose, 24 (9), pp. 4057-4068. https://doi.org/10.1007/s10570-017-1389-4
15. Krishnamoorthy, K .; Navaneethaiyer, U .; Mohan, R .; Lee, J .; Kim, SJ (2012). Graphene oxide nanostructures modified multifunctional cotton fabrics. Applied Nanoscience volume, 2 (2), pp. 119-126. https://doi.org/10.1007/s13204-011-0045-9
16. Liao, KH; Lin, YS; Macosko, CW; Haynes, CL (2011). Cytotoxicity of graphene oxide and graphene in human erythrocytes and skin fibroblasts. ACS applied materials & interfaces, 3 (7), pp. 2607-2615. https://doi.org/10.1021/am200428v
17. Liu, X .; Qin, Z .; Dou, Z .; Liu, N .; Chen, L .; Zhu, M. (2014). Manufacture of conductive poly (ethylene terephthalate) nonwoven fabrics using an aqueous dispersion of reduced graphene oxide as a sheet dyestuff. RSC Advances, 4 (45), pp. 23869-23875. https://doi.org/10.1039/C4RA01645A
18. Miao, GY; Zhang, ZZ (2017). Anti-UV finish of cotton fabrics with graphene oxide. Dyeing & Finishing, 02. https://en.cnki.com.cn/Article_en/CJFDTotal-YIRA201702010.htm
19. Pelin, M .; Fusco, L .; Leon, V .; Martín, C .; Criado, A .; Sosa, S .; Prato, M. (2017). Differential cytotoxic effects of graphene and graphene oxide on keratinocytes of the skin. Scientific Reports, 7 (1), pp. 1-12. https://doi.org/10.1038/srep40572

21. Qu, G .; Wang, X .; Wang, Z .; Liu, S .; Jiang, G. (2013). Cytotoxicity of quantum dots and graphene oxide to erythroid cells and macrophages. Nanoscale Research Letters, 8 (1), pp. 1-9. https://doi.org/10.1186/1556-276X-8-198
22. What, J .; He, N .; Patil, SV; Wang, Y .; Banerjee, D .; Gao, W. (2019). Screen printing of graphene oxide patterns onto viscose nonwovens with tunable penetration depth and electrical conductivity. ACS applied materials & interfaces, 11 (16), pp. 14944-14951. https://doi.org/10.1021/acsami.9b00715
23. Rani, KV; Sarma, B .; Sarma, A. (2018). Plasma treatment on cotton fabrics to enhance the adhesion of Reduced Graphene Oxide for electro-conductive properties. Diamond and Related Materials, 84, pp. 77-85. https://doi.org/10.1016/j.diamond.2018.03.009
24. Ren, J .; Wang, C .; Zhang, X .; Carey, T .; Chen, K .; Yin, Y .; Torrisi, F. (2017). Environmentally-friendly conductive cotton fabric as flexible strain sensor based on hot press reduced graphene oxide. Carbon, 111, pp. 622-630. https://doi.org/10.1016/j.carbon.2016.10.045
25. Sahito, IA; Sun, KC; Arbab, AA; Qadir, MB; Jeong, SH (2015). Integrating high electrical conductivity and photocatalytic activity in cotton fabric by cationizing for enriched coating of negatively charged graphene oxide. Carbohydrate polymers, 130, pp. 299-306. https://doi.org/10.1016/j.carbpol.2015.05.010
26. Shateri-Khalilabad, M .; Yazdanshenas, ME (2013). Fabricating electroconductive cotton textiles using graphene. Carbohydrate Polymers, 96 (1), pp. 190-195. https://doi.org/10.1016/j.carbpol.2013.03.052
27. Shathi, MA; Chen, M .; Khoso, NA; Rahman, MT; Bhattacharjee, B. (2020). Graphene coated textile based highly flexible and washable sports bra for human health monitoring. Materials & Design, 193, 108792. https://doi.org/10.1016/j.matdes.2020.108792
28. Tang, X .; Tian, M .; Qu, L .; Zhu, S .; Guo, X .; Han, G .; Xu, X. (2015). Functionalization of cotton fabric with graphene oxide nanosheet and polyaniline for conductive and UV blocking properties. Synthetic Metals, 202, pp. 82-88. https://doi.org/10.1016/j.synthmet.2015.01.017
29. Tian, M .; Hu, X .; Qu, L .; Du, M .; Zhu, S .; Sun, Y .; Han, G. (2016). Ultraviolet protection cotton fabric achieved via layer-by-layer self-assembly of graphene oxide and chitosan. Applied Surface Science, 377, pp. 141-148. https://doi.org/10.1016/j.apsusc.2016.03.183
30. Wang, T .; Zhu, S .; Jiang, X. (2015). Toxicity mechanism of graphene oxide and nitrogen-doped graphene quantum dots in RBCs revealed by surface-enhanced infrared toxicity mechanism of graphene oxide and nitrogen-doped graphene quantum dots in RBCs revealed by surface-enhanced infrared absorption spectroscopy. Toxicology Research, 4 (4), pp. 885-894. https://doi.org/10.1039/c4tx00138a