A Review on Biocompatibility of Graphene-Based Material

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Abstract: This review mainly focuses on the research of biocompatibility of graphene-based material in the past few years. As graphene-based material has been considered a great candidate for biomedical use, it attracts great interests of many researchers.It is not clear yet that whether the graphene and its derivatives are safe enough to be the biosensor in human's body. Common graphene is always to have reaction with human's substance inside and produce harmful substance. However, some of its derivatives may do not have the same problem. So, this research proposal wants to find out the cytotoxicity of the graphene and its derivatives. In addition, the review wants to conclude a standard about to what extent of cytotoxicity is the graphene-based material allowed to be used in human's body and do not produce harm to our health.Therefore, biocompatibility of graphene-based material has gradually become the topic of various scientists. This review summarizes the latest researches in the past few years and different results. In conclusion, future path of the research is given and what has to be emphasized is that before graphene-based material is in vivo applications, its biocompatibility must be clearly examined.

Keywords: Graphene-Based Material; Biocompatibility; Cell

Introduction

In 2010, Andre Geim and Novoselov was prized the Noble Prize for their excellent research in the material of graphene. Since then this kind of material is used in various area for its brilliant characteristic, such as batteries, chips, transistors, and so on. Not long after that, many scientists begin to notice its great behavior in sensor industry. After that, scientists begin to research its affection in biosensor area. In a recent study, the researchers put the concept of nano-graphene and nano-graphene-oxide, which has been used in many biomedical area. From the research, when the cancer cell in human's body is in a high level, they will combine with a substance on it which is called target ligand. When this happens, the computer will raise the data and put the relevant function on the screen. By this way, the doctors will be able to judge whether the patients are suffering the cancer. As a new-fashioned material, graphene also has been reported to have antibacterial, antiplatelet, and anticancer properties. It also has the potential to deliver drugs to a specific part of human's body. Even if the technology is not mature yet, it will probably to have some breakthrough in the near future. In this way, biocompatibility of graphene has become crucial for its applications related to human. Therefore, this review collects data from various paper about their view of biocompatibility of graphene-based materials. Next, the review raised some data and figures to clearly show the experiment result about biocompatibility of graphene based material to the cells. At the end of the view, the review makes a conclusion and write about some conclusion about future works on researches of biocompatibility of graphene-based materials.

1. Main body:(GBMs=graphene-based materials) (conclusions from different authors' angles)

Graphene is a kind of newly fashioned material which has been used in different industries. Owing to its characteristic of one-thick compound, it has been used to diagnose many kind of diseases. [1] Graphene can penetrate a single cell in a small volume, so it can be used as a drug carrier to provide more paths for medicine to be a candidate for ; it is believed that the future technological development brought by other fields will also provide greater support for the precision medicine industry. [2] For example, it is the best material known for conducting electricity and heat. According to a recent research, it is found that graphene and its derivatives are also an excellent material used for detecting cancer in human's body. [3] After attaching the graphene with the biosensor, it can greatly improve the biosensor's function. In addition, the biosensor is able to have specific detection with its help.Graphene is a layer of carbon which is connected with overlapping sp2 bonds. The most significant properties of graphene comes from the 2p structure, which makes the p-band to the carbon which produces graphene. From past studies of graphene, researchers have noticed that graphene is very rigid, which makes it reveals much high heat conductivity, and it is particularly impressive to gases. Owing to these properties, graphene is found to be very fit for similar materials, which has been used in different applications. As a result, a good graphene is needed for commercial applications.[12] Graphene has the biggest tense with stiffness which is almost linked with graphite. As a result, it has attracted the attention of many researchers. A technique which can administrate statistic stress and make frequency under great tensile. A strain of graphene layer was seen which is using a method through administrating change in a peak. Conclusively, the most significant properties is decided on the distribution in the host matrix, destruction concentration, face bonding, some ratio, and so on. An deliberation in tensile strength of the components with destruction concentration represents improved mechanical function of the component and is able to effectively transmit loading in both graphene and polymer.

2. What decides the effect of GBMs to human's cell:

1: Sometimes GBMs gained from different sources or ways are dcalled the same names. However in fact their chemical and physical properties are totally different. For this reason, it is difficult to give exact conclusions.[1]

2: Graphene oxide can lower cell adhesion and therefore produce cell apoptosis. GO can also enter lung cells and make people get inflammation. Therefore, maybe graphene oxide do not have a good application prospect used in human's body.[2]

3: Studies should focus more on synthesis of graphene using biological molecules. Owing to the functions of graphene based materials depend on the size, surface, the number of layer, lateral dimensions and so on. There might be fitness.[3]

3. Problem existed

It is not clear yet that whether the graphene and its derivatives are safe enough to be the biosensor in human's body. Normal graphene is possibly to have chemical reaction with human's body and produce harmful substance. However, some of its derivatives may do not have the same problem. So, in this research proposal wants to find out the cytotoxicity of the graphene and its derivatives. In addition, the review wants to conclude a standard about to what extent of cytotoxicity is the graphene-based material allowed to be used in human's body and do not produce harm to our health.If we are able to select the safe graphene or its derivatives from others, we are able to use these material to attach the biosensor, and then our fighting against the cancer will step a little further. Because if we are able to diagnose the cancer cell in the early time, the chance to cure it will greatly improve. In addition Graphene is regarded as the best material known to be used in a sensor.

The most tricky problems now is that whether the graphene and its derivatives are harmful to human's body is not sure

yet. Unless its safety is well examined, the technology will not be put into use. So it is an urgent thing to try to solve the problem which has disturbed the scientists for a long period of time about the issue.According to a theory, most graphene and its derivatives are able to process chemical reaction and produce harmful substance inside human's body. To get a relatively safe material, it is possible to need to process a kind of human-made derivatives to avoid reaction. So it is still a long way to go to find a kind of absolutely safe derivatives to human's body.

1.Some data and pictures

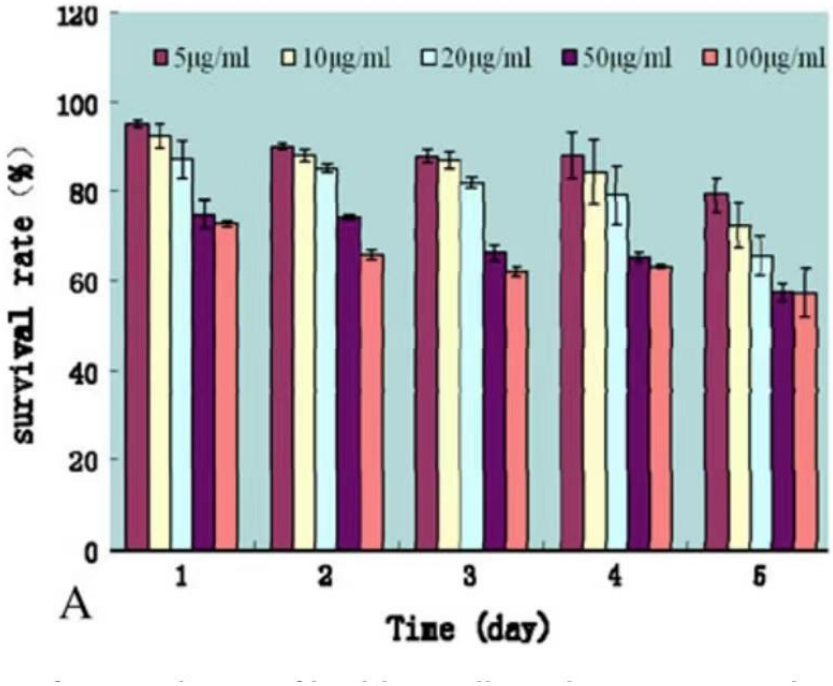

Figure 1 The effects of GO on human fibroblast cells

Figure 1 shows the effects of GO on human fibroblast cells: the existing rate at different levels of GO and different time,the right picture shows location of GO inside HDF cells.[4] This figure clearly shows that this kind of graphene oxide decrease the survival rate of human's fibroblast cells. And as the concentration gets higher and days go by, the survival rate will become lower.

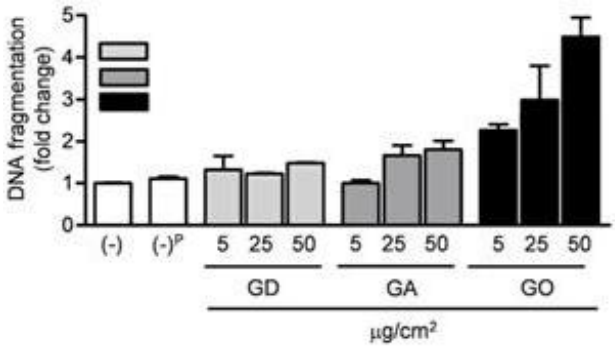

Figure 2

In another research, as the figures show, researchers find out that minimizing oxidation will lower the DNA blast. And graphene oxide, which decreases the mitochondrial generation and cell destruction in a specific kind of cell. Cells is able to stably express a localized oxidant sensitive GFP probe were exposed to increasing concentrations of dispersed graphene in 2 per cent, aggregates of graphene in water, graphene oxide, water or water with 2 percent and oxidation of the probe was

measured using flow a few hours later. MLE-12 cells were exposed as in and cell death was measured 24 hours later using a DNA destruction ELISA.[5] As their conclusion shows, minimizing oxidation and stable nanoscale dispersion improves the biocompatibility of graphene in the lung.

A recent research shows the damage function of graphene. [6] Graphene is able to go into the cells through all kinds of ways. It is also very likely toproduce physical damage to the cell membrane through penetration. As long as it enters, it can decrease oxidative stress through improving production causing changes in cell membrane potential. Graphene is also likely to be an electron acceptor stopping the electron transmission chain and lowering ATP level. Therefore ROS formed can decrease DNA damage; release of cytokines which causes inflammation. Cells experience apoptosis and programmed cell death as a result of more DNA damage, oxidative stress or inflammation.There are two main methods: penetrating cell membranes and inhibiting the electron transport.

4. Conclusion（Approaches to reduce toxicity）

As far as what have been found, nearly all kinds of GBMs will decrease human cell viability. However, in my opinion, it does not mean that all GBMs do not fit for human's body. If we can use chemical methodology to make synthesis of graphene, and with some guidelines of to be set standards, probably safe kinds of GMBs will be produced.

References

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