New material for surgical dressings shown to prevent recurrence of melanoma and enhance healing

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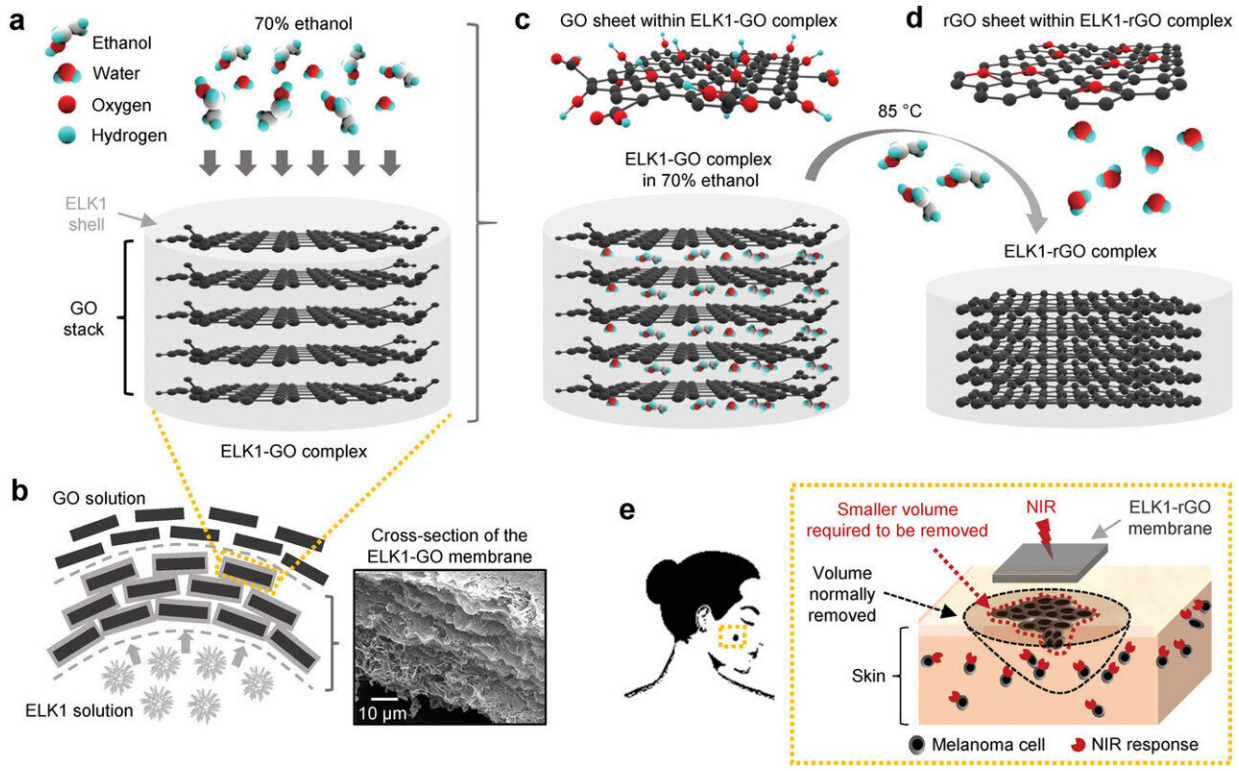

Rationale of the ELK1-GO membrane reduction process and application. Illustration depicting a). exposure of 70% ethanol to an ELK1-GO complex comprising stacks of GO. b). ELK1-GO complexes form multi-layered ELK1-GO membranes, which are co-assembled at the interface of a GO solution and an ELK1 solution. c). Ethanol molecules penetrate the ELK1 protein shell and bind the oxygen-containing groups present on the GO sheets. d). Upon heating up to 85 °C, the GO sheets lose oxygen-containing groups resulting in GO reduction (rGO) and, consequently, a decrease in the thickness of the

ELK1-rGO complex. e). Illustration depicting the use of the resulting ELK1-rGO membranes as surgical dressings for the postoperative NIR treatment of melanoma. The photo-thermal therapy (PTT) efficiency of the surgical dressings would enable much smaller surgical resections (area within red dashed line) compared to normal procedures requiring large resections (area within black dashed line). The NIR treatment would also enable elimination of residual melanoma cells. Credit: *Advanced Functional Materials* (2022). DOI: 10.1002/adfm.202205802

A new type of dressing for post-surgical treatment of melanoma has been created by scientists who have discovered a new method for making a material that can kill cancer cells and simultaneously regenerate healthy ones.

Scientists from the University of Nottingham have combined graphene oxide, elastin, and ethanol to develop a new method to make this material conductive so it can be heated to kill melanoma cells but not other cells around it. The research has been published in *Advanced Functional Materials*.

Surgical resection (the process of removing a piece of tissue) is a common treatment for skin melanoma but can lead to post-operative recurrence, which can need further surgery plus chemotherapy and radiotherapy. It can also be hard to treat due to tumor cells often developing resistance to treatments. The use of Photothermal Therapy (PTT), which relies on conductive materials that can convert light into heat to kill cancer cells, is being explored as a new treatment and this new research demonstrates how this could be applied using a dressing with minimal exposure to light needed.

Graphene oxide (GO) offers the possibility to be integrated with other materials such as proteins and the team has used this approach to

assemble thin GO-elastin membranes that promote cell growth. However, GO is not conductive enough. Making it conductive usually requires harsh processes and high temperatures of over 140°C that limits its use. In this study, the researchers developed an innovative method to make GO conductive in an efficient manner but requiring lower temperatures (85°C). This process enabled the fabrication of GO-elastin materials that are conductive and can promote the growth of immune boosting endothelial cells to promote regeneration and healing.

Using this method, dressings have been created that only need to be heated using Near Infrared light (NIR) for 15 seconds every 48 hours to be effective. NIR is currently used for some skin treatments and can be delivered by the patient at home. The addition of the ethanol in the dressing means it is also sterile, promoting healing and reducing the risk of infection.

"We know that graphene oxide (GO)-protein materials offer huge potential for biomedical devices but the need for harsh processes to make graphene oxide conductive at high temperatures has limited their use. Our new method offers a solution to this, enabling the fabrication of protein-based materials with both efficient photothermal conductivity and bioactive properties. These materials could be used as dressings for post-surgery treatment and healing of skin cancer, operating within a narrow temperature window where 'bad' cells are killed and 'good' cells are not," says Professor Alvaro Mata, School of Pharmacy, University of Nottingham.

Dr. Yuanhao Wu, a biomedical engineer and plastic surgeon who led the study said that "given the aggressive nature of melanoma, surgical resections to remove it have to be significantly larger than the size of the tumors to minimize the presence of residual cells. This creates a new wound and delays healing. Beyond the prevention of tumor recurrence and promotion of tissue healing, our dressings could also lead to smaller

surgical resections and practical post-surgery treatments that are non-invasive and could be delivered at home."

More information: Yuanhao Wu et al, Disinfector-Assisted Low Temperature Reduced Graphene Oxide-Protein Surgical Dressing for the Postoperative Photothermal Treatment of Melanoma, *Advanced Functional Materials* (2022). DOI: 10.1002/adfm.202205802