IOCXe 2026 Conference

The 1st International Online Conference on Xenobiotics

22–23 June 2026 | Online

STUDY OF THE CYTOTOXICITY OF PEGYLATED EXPANDED GRAPHENE OXIDE IN HUMAN ENDOTHELIAL CELLS

Arisbel Cerpa-Naranjo*[1], María Fuencisla Guilsanz-Muñoz[2] , Javier Perez-Piñeiro[2] , María S. Fernández-Alfonso*[3] , Marta Sanz-Gómez[3], Elvira Bragado-García[3]

[1] Department of Engineering. School of Architecture, Engineering, Science and Computing European University, Villaviciosa de Odón 28670, Madrid. Spain. arisbel.cerpa@universidadeuropea.es

[2] Department of Sciences and Aerospatial, School of Architecture, Engineering, Science and Computing. European University, Villaviciosa de Odón 28670, Madrid, Spain. mariafuencisla.gilsanz@universidadeuropea.es, javier.perez4@universidadeuropea.es

[3] Pluridisciplinary Institute. Complutense University of Madrid. Madrid 28040. Spain. marisolf@ucm.es, masanz09@ucm.es, ebragado@ucm.es

INTRODUCTION & AIM

Graphene-based nanomaterials have attracted considerable attention in biomedical applications due to their unique physicochemical properties, including a large surface area and versatile surface functionalization [1,2,4]. Among them, expanded graphene oxide (EGO) offers enhanced structural characteristics that can be further optimized by functionalization with polyethylene glycol (PEG), thereby increasing its stability and biocompatibility. [3,4].

In this study, PEGylated expanded graphene oxide was synthesized and characterized using Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). Furthermore, its cytotoxicity in human endothelial cells was evaluated using different biological media (bovine serum albumin [BSA] and fetal bovine serum [FBS]). Additionally, the internalization of expanded graphene oxide in BSA and FBS was assessed using transmission electron microscopy (TEM) to determine its potential in biomedical applications.

OBJETIVES

- Synthesis of pegylated expanded graphene oxide.
- Structural and morphological characterization: Infrared Spectroscopy, scanning electronic microscopy
- Cytotoxicity assay in endothelial cells
- Internalization study by Transmision Electron Microscopy

METHOD

Cytotoxicity of EGO and PEGylated EGO was evaluated in human endothelial cells. Materials were studied in the absence and presence of BSA and FBS.

SYNTHESIS AND CHARACTERIZATION

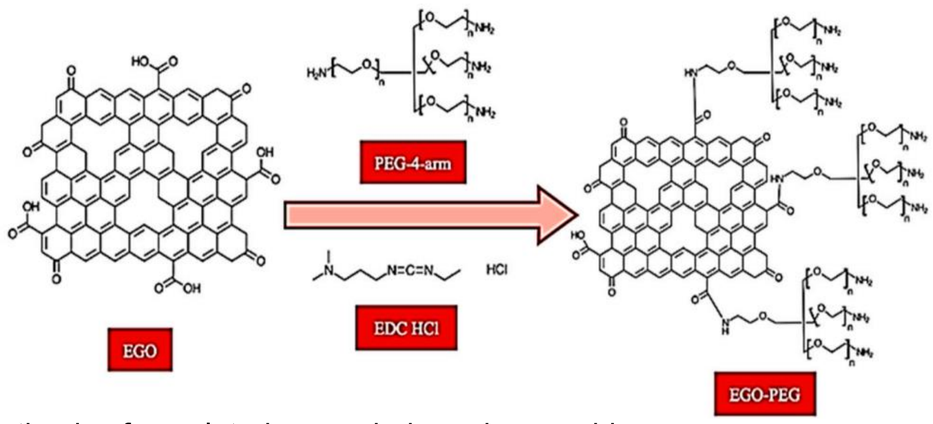

Figura 1. Synthesis of pegylated expanded graphene oxide.

Infrared Spectroscopy

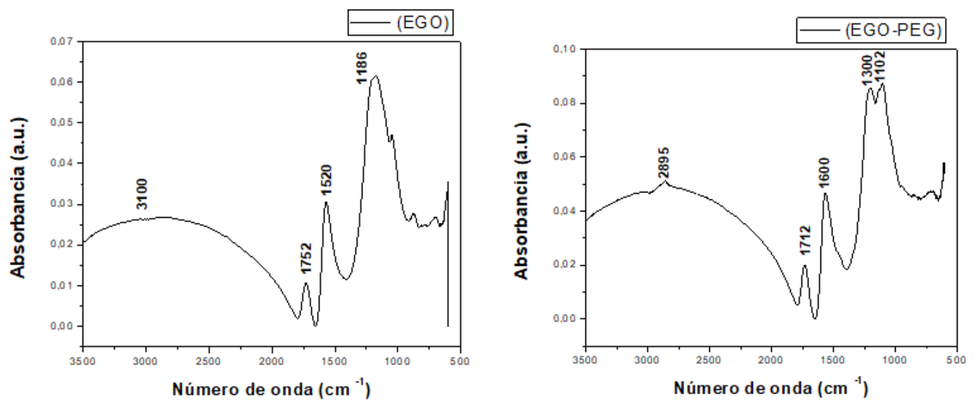

Figura 2. Infrared spectra of expanded graphene oxide and PEGylated EGO

Scanning Electron Microscopy (SEM)

Both samples exhibit the characteristic layered morphology commonly observed in graphene-based materials, consisting of corrugated and overlapping sheets. PEG incorporation induces significant morphological changes, mainly associated with increased aggregation of graphene oxide layers and a reduction in apparent porosity

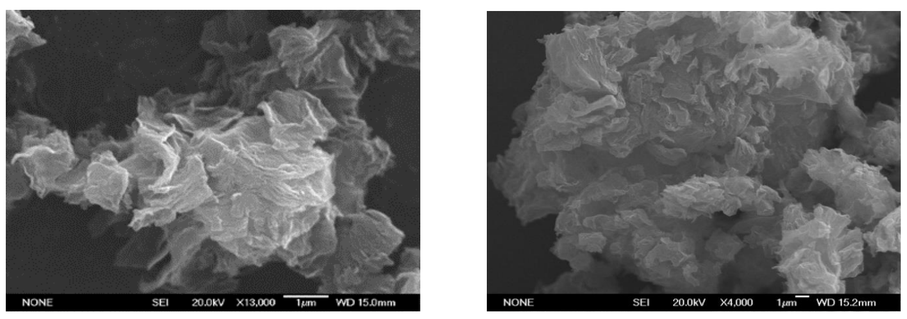

Figura 3. Scanning Electron Microscopy of expanded graphene oxide and PEGylated EGO.

RESULTS & DISCUSSION

CYTOTOXICITY ASSAY

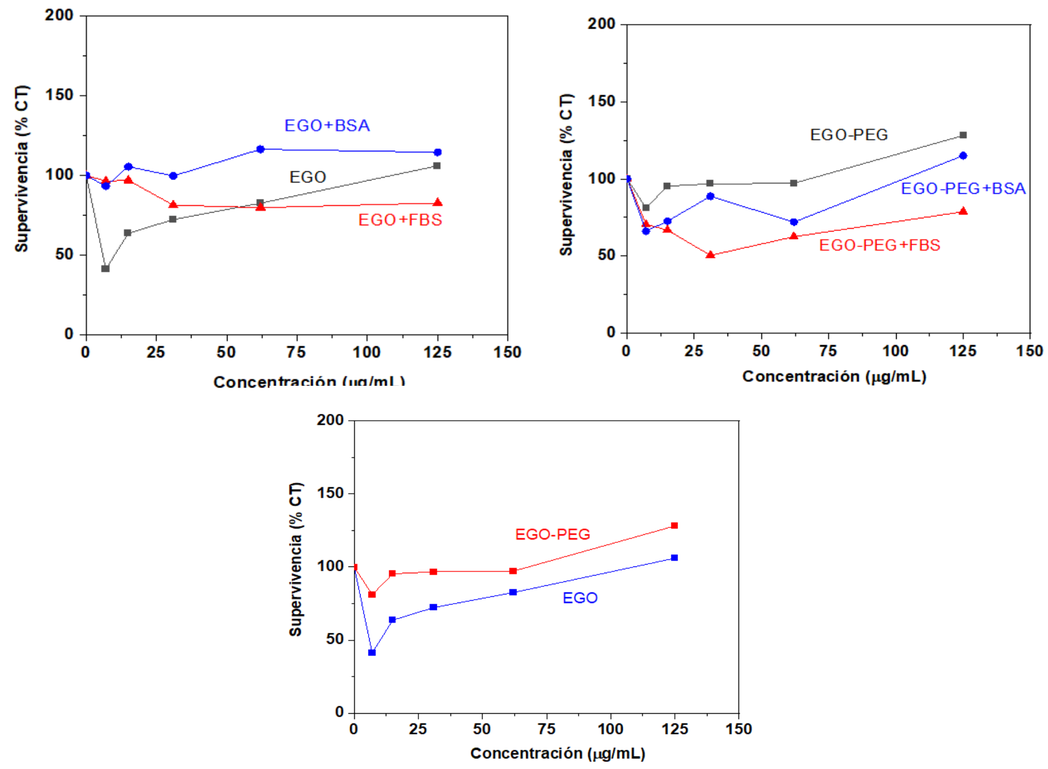

Figura 4. Supervival (% CT) vs concentration of expanded Graphene oxide and pegylated conjugate in different biological médium (BSA and FBS).

INTERNALIZATION OF EXPANDED GRAPHENE OXIDE (EGO) INTO CELLS

Cellular uptake was investigated by transmission electron microscopy (TEM).

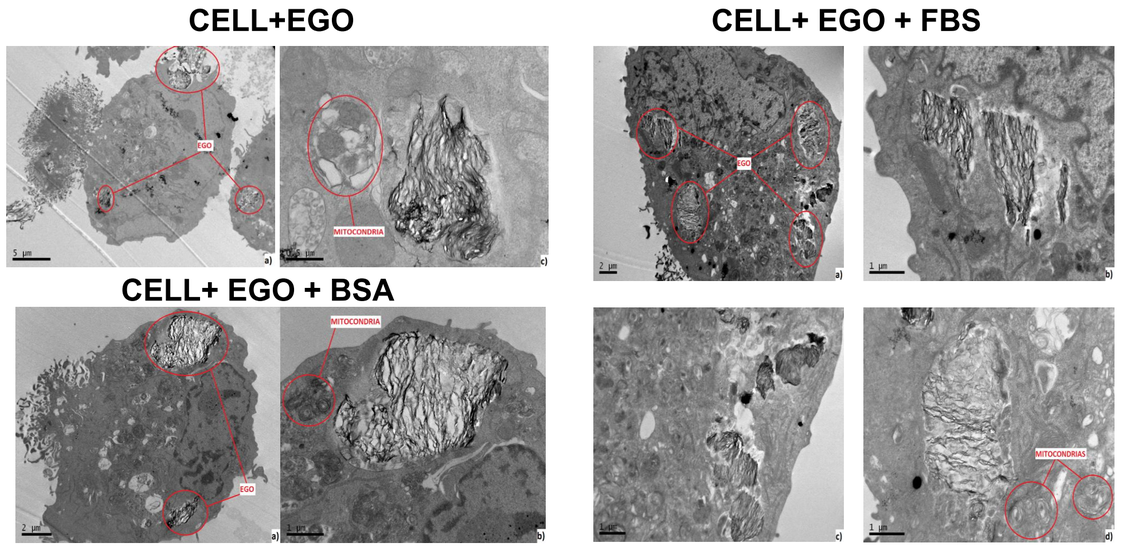

Figura 5. Transmission electron microscopy (TEM) images. Internalization of expanded graphene oxide in human endothelial cells in the presence of different biological media (FBS and BSA).

CONCLUSION

- Pegylated EGO is obtained through the synthesis of EGO and PEG by coupling the amide group (NH-CO).
- A reduction in EGO cytotoxicity is observed in endothelial cells when BSA and FBS are present. PEGylated EGO exhibits improved biocompatibility. BSA reduces cytotoxicity through a protective protein corona. FBS promotes greater cellular uptake and lower viability.
- The biological identity acquired by nanomaterials strongly influences their biological response.
- Internalization of EGO into cells. The agglutination of the carbon-based nanostructure can cause cell damage if it reaches a considerable size. The presence of EGO in cells can cause mitochondrial degradation.
- The correlation between TEM observations and cytotoxicity suggests that higher intracellular accumulation is associated with lower viability.

REFERENCES

1. **Sontakke AD, Tiwari S, Purkait MK.** *A comprehensive review on graphene oxide-based nanocarriers: Synthesis, functionalization and biomedical applications.* Materials Today Chemistry. 2023;38:100484.
2. **Bellier N, Baipaywad P, Lee JY, Park H.** *Recent biomedical advancements in graphene oxide- and reduced graphene oxide-based nanocomposite nanocarriers.* Biomaterials Research. 2022;26:1–30.
3. **Wu SY, An SSS, Hulme J.** *Current applications of graphene oxide in nanomedicine.* International Journal of Nanomedicine. 2015;10:9–24.
4. **Ghosh S, Chatterjee K.** *Poly(Ethylene Glycol) Functionalized Graphene Oxide in Tissue Engineering: A Review on Recent Advances.* International Journal of Nanomedicine. 2020;15:5991–6006