Graphene quantum dots: physico-chemical characterization and in vitro biological effects

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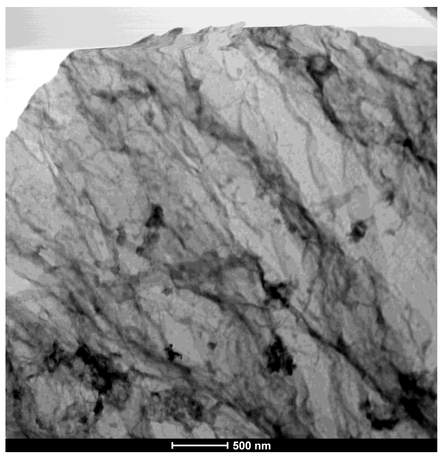
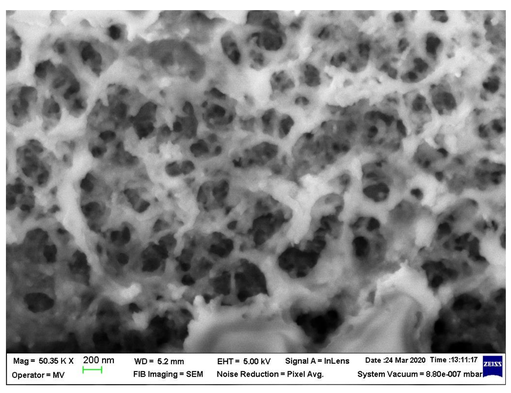
INTRODUCTION

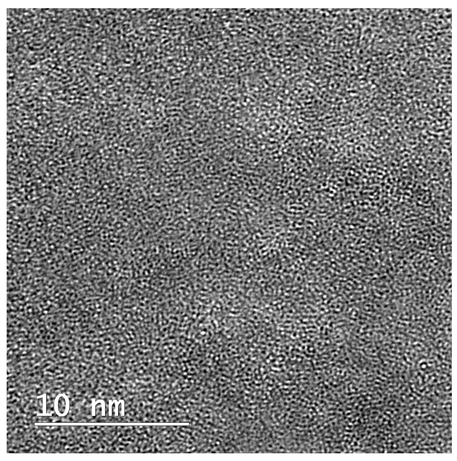
- ✓ Graphene quantum dots (GQDs) represents nanoscale structures with strong quantum property and exceptional photoluminescence properties.
- ✓ These particles have promising applications in nanomedicine, specifically for diagnostics, cargo delivery, photothermal therapy and bioimaging.
- ✓ In this context, we aimed to characterize GQDs available on the market for a further utilization for in vivo purposes.

EXPERIMENTAL PROCEDURE

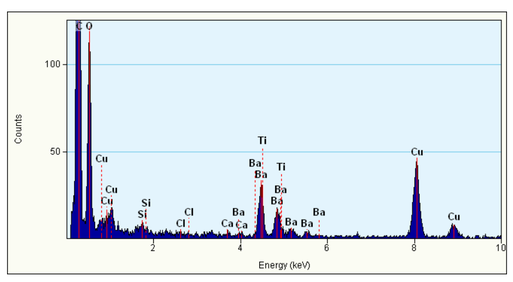
- ✓ Transmission and scanning electron microscopy (TEM and SEM), and energy dispersive X-ray spectroscopy (EDX) were used to characterize the morphology and elemental composition of GQDs.
- ✓ In addition, the hydrodynamic size and the zeta potential were measured for these nanoparticles.
- ✓ Their biocompatibility was investigated on human fibroblast lung cells (MRC-5 cell line) after 24 and 72 hours of incubation with concentrations up to 200 µg/mL of GQDs.







TEM and SEM images of GQDs.
EDX analysis of GQDs

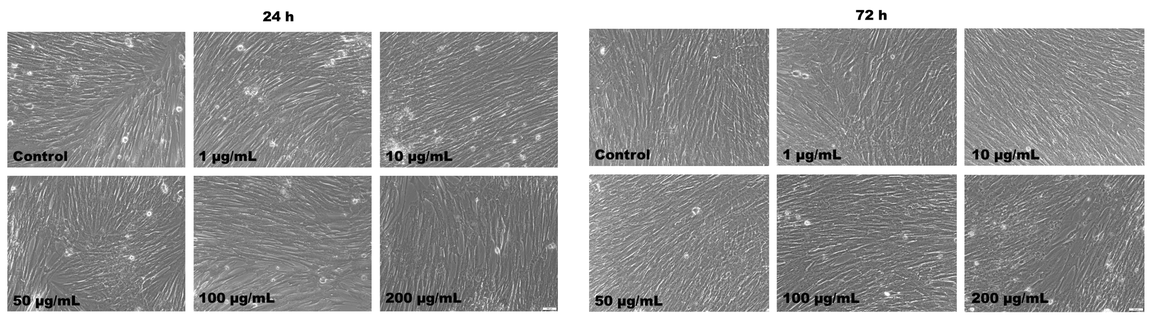


TEM images showed graphene sheets with few wrinkle structures, the dots having uniform diameter in the range between 1.0 and 5.0 nm. SEM examination revealed the three-dimensional structure with a sponge-like aspect and pores of various sizes.
Their tendency to aggregate provided the formation of aggregates with sizes of hundreds of nanometers, as it was revealed by the hydrodynamic diameter of about 270 nm. A negative zeta potential of -16 mV confirmed the anionic character of GQDs.

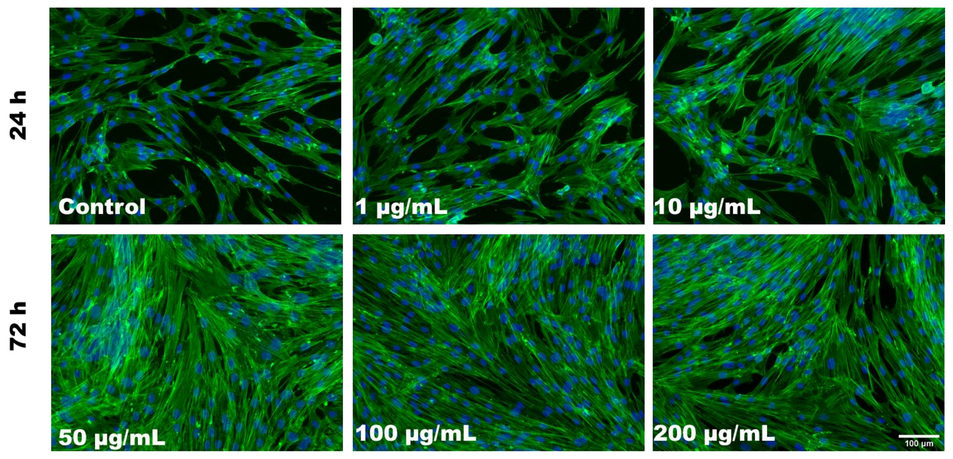
Acknowledgements. M.S. Stan acknowledges the support of the Operational Programme Human Capital of the Ministry of European Funds through the Financial Agreement 51668/09.07.2019, SMIS code 124705.

RESULTS

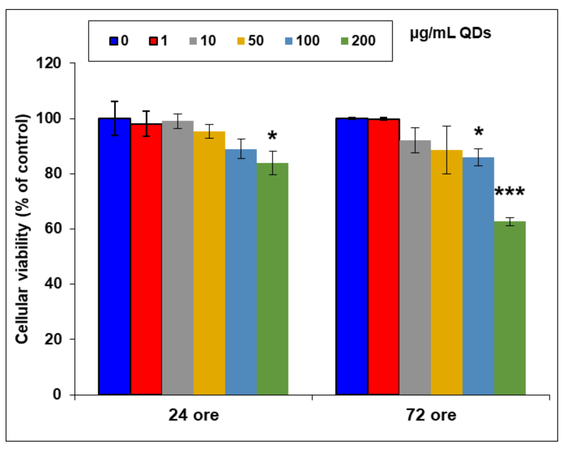
Concentrations up to 50 µg/mL exhibited a low toxicity in lung cells as revealed by MTT assay and fluorescent microscopy of actin cytoskeleton after both time intervals, confirming a potential further testing on animals for clinical purposes.



Phase contrast images of MRC-5 cells incubated with GQDs



Fluorescence images of F-actin in MRC-5 cells incubated with GQDs



CONCLUSION

The high doses of GQDs induced cell death and must be avoided in future.
Given the new experimental evidences obtained on GQDs, more knowledge has been achieved, which is very useful for prospective research to revolutionize the future of nanomedicine and biotechnology.