

## TUNABLE PAOX-BASED NANOFORMULATIONS

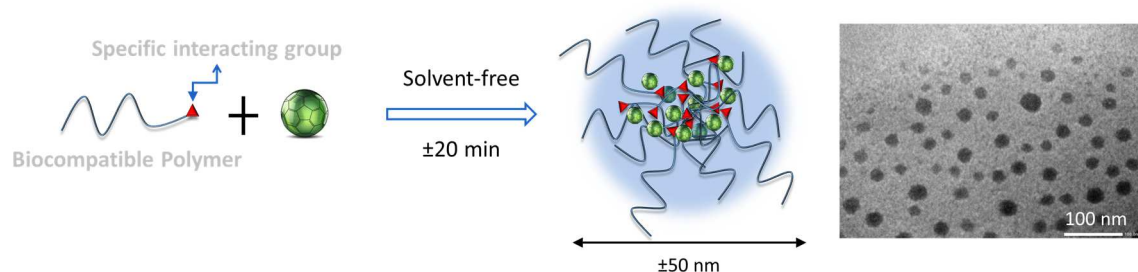
We are seeking partners interested in tunable poly(2-oxazoline)-based nanoformulations as a solution for improved fullerene formulations for applications in **biomedical**, **biological**, **cosmetic** or **agricultural** settings.

### INTRODUCTION

Fullerenes are of particular interest for biological and cosmetic purposes because of their powerful antioxidant and photosensitizer properties. However, their extremely low water solubility limits their bioavailability. The water solubility can be increased by chemical modification, which, however, provides poor control of regioselectivity and could lead to the loss of the intrinsic properties of fullerene and change the toxicology profile. Therefore a supramolecular approach has been developed to solve the issue and to maintain the intrinsic properties of the fullerenes.

### TECHNOLOGY

Researchers at Ghent University in the research group of Prof. Richard Hoogenboom have developed a simple, green approach to produce water-soluble fullerene formulations through complexation with water soluble biocompatible polymers such as poly(ethylene glycol), poly(*N*-vinylpyrrolidone) and poly(2-oxazoline)s (PAOx).



Potential applications of fullerenes in a biological setting are inhibited by its low water solubility. The figure illustrates our approach to increase the bioavailability of fullerenes.

### APPLICATIONS

The technology could mainly be used to address applications which need fullerene in its water soluble form. These applications mainly focus on either the **antioxidant**, **photosensitizing** or **UV-protective properties** of fullerene. Hence, these water soluble formulations can be used in anti-ageing applications, both cosmetic and medical, aimed at slowing the ageing process and/or as a treatment for oxidative stress related diseases. In addition, antioxidants are often used to slow spoilage of food, therefore fullerene nanoformulations could serve as a food preservative agent. Furthermore, fullerenes absorb harmful UV-irradiation efficiently, therefore having applications in UV-protection of skin, pigments and materials.

Water soluble fullerene supplementation has also been studied on agricultural crop, where it was found to boost biomass, water content and fruit yield remarkably.

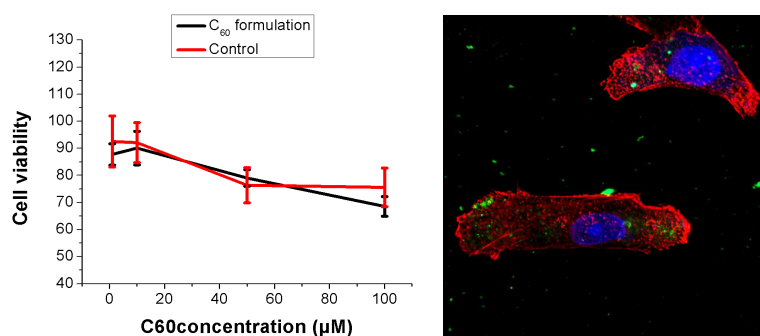
Lastly, under the right conditions they can be applied for photodynamic therapy, in order to treat malignant tumors in a non-invasive manner.

## ADVANTAGES

- The nanoformulations can be produced in a fast, **green** and solvent free manner, therefore eliminating the need for tedious purifications
- **Tunability**: different types of polymers can be used for the complexation, allowing the incorporation of other functional groups (*e.g.* targeting moieties, fluorescent labels)
- A relatively **high content of fullerenes** are incorporated into the nanoformulations up to 10 weight per cent
- **Stability**: the provided nanoformulations are stable for extended periods (months) of time in aqueous solutions.

## STATUS OF DEVELOPMENT

Proof of concept for the complexation and preparation of stable fullerene nanoparticles with different sizes (50-200 nm) has been delivered. Currently we are further investigating the influence of the process parameters on the obtained nanoparticles and starting the biological evaluation. The first cytotoxicity and cellular uptake assays have been performed indicating the non-toxic nature and efficient uptake of the fullerene nanoformulations.



Left: MTT-assay on RAW 264.7 macrophages of a C<sub>60</sub>-Poly(2-oxazoline) formulation.  
Right: cellular uptake of fluorescently labeled C<sub>60</sub>-Poly(2-oxazoline) formulation.

## PARTNERSHIP

We are interested in collaborations/partnerships/licenseses to further explore the potential of our fullerene formulations for treatment of or for slowing the onset of several degenerative diseases. We offer tunable poly(2-oxazoline) platform to make water soluble fullerene solutions.

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## KEYWORDS

Fullerene, nanoformulation, biocompatible polymers, ROS-induced diseases, antioxidant, photosensitizer, UV-protection, poly(2-oxazoline)s

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