Gellan-gum coated gold nanorods: A new tool for biomedical applications

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Introduction:

Gold nanorods (AuNRs) have been widely studied, in the scope of cancer research and biomedical applications [1]. Their optical properties, easy synthesis and high surface area make AuNRs an outstanding tool for a plethora of applications, such as drug delivery, imaging and tissue engineering [2]. However, before biomedical usage, it is necessary to modify AuNRs surface chemistry, to improve their biocompatibility and stability under biological conditions [3]. One possible approach is the use of biocompatible natural-based polymers that enhance AuNRs performance while allowing the controlled release of drugs/bioactive agents. Herein, we report the successful preparation of a core-shell nanostructure using low-acyl gellan gum (GG) [4], [5] for the coating of AuNRs.

Methods:

AuNRs were prepared following the seed-mediated growth method [6]. Then, particles were coated with a successive deposition of anionic and cationic polyelectrolytes (poly(acrylic acid) and poly(allylamine hydrochloride), respectively). The pre-coated nanorods were added to a low-acyl gellan gum (GG) solution, previously heated at 90ºC to allow dissolution, and the mixture was stirred overnight at room temperature. The GG-coated AuNRs (AuNR-GG) were characterized by UV-visible spectrometry, zeta potential measurements and transmission electron microscopy (TEM). AuNRs cytotoxicity was accessed *in vitro* after 1, 3, 7 and 14 days of SaOS-2 cell culture, using an MTS assay. Nanoparticles internalization was confirmed by TEM. *In vivo* biocompatibility tests were also performed by delivering a solution of AuNRs-GG via tail injection in mice.

Results and Discussion:

AuNRs were successfully synthesized and coated with a GG shell of approximately 7 nm, as shown in Figure 1. The presence of the GG around AuNRs clearly improved particles stability at different salt and pH conditions, as observed by UV-vis spectroscopy. The *in vitro* studies using SaOS-2 showed that AuNRs-GG are non-cytotoxic. TEM analyses have confirmed that nanoparticles are uptaken by cells and aggregate within cytoplasmic vesicles as depicted in Figure 2. Additionally, *in vivo* tests suggest that AuNRs are harmless for mice after 24 hours.

Conclusion:

In this study, AuNRs were individually coated with a gellan gum (GG) shell, resulting in nanoparticles with enhanced stability under different salt concentrations and range of pH's. Thence, one can conclude that the GG present around the nanoparticles acts as a stabilizer, improving AuNRs stability and biocompatibility.

AuNRs-GG have shown noteworthy features and a high potential for further use on biomedical applications including intracellular drug delivery and imaging.

Figure 1:

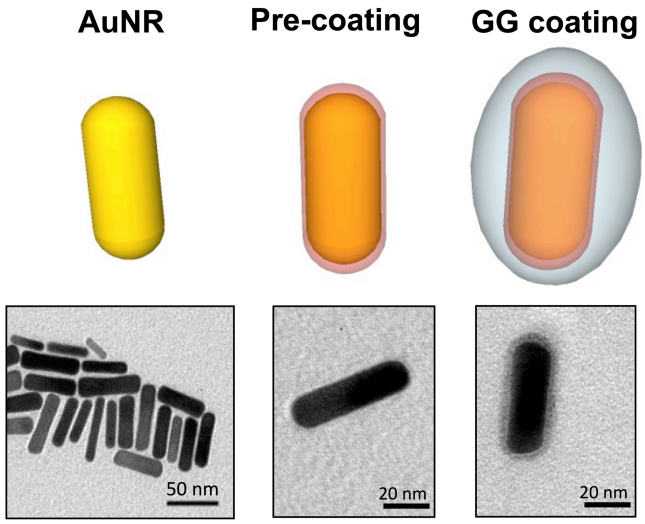

Figure 1 – Schematic representation of AuNR-GG synthesis and TEM images of AuNRs at different steps of the coating procedure (bottom).

Figure 2:

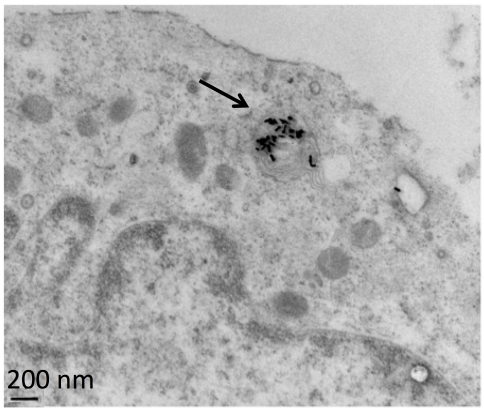

Figure 2 – TEM images of SaOS-2 cultured with AuNRs-GG for 14 days. Black arrow indicate AuNRs-GG agglomerate.

References:

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