

Functionalized gold-iron nanoparticles obtained by laser ablation in liquid for RNA-delivery in cells

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The aim of this project is the development of an RNA-delivery vector effective at cellular level, using gold-iron nanoalloys^[1] functionalized with ThioGlucose (TG) and MercaptoPhenylBoronic Acid (MPBA). The latter contains a boronic acid group well known in scientific literature for efficiently linking to the ribose unit present in several biomolecules such as RNA and ATP.^[2] The idea is to deliver RNA inside the cell thanks to MPBA-functionalized nanoparticles and then releasing the RNA strands due to the presence of ATP molecules, which are expected to cleave the MPBA-ribose bonding.^[3] The synthesis of these NPs is achieved through Laser Ablation in Liquid (LAL), with a set up which consists of a metallic target in a liquid solution irradiated by a 1064nm nanosecond laser pulses to produce the required particles;^[4] in order to functionalize the NPs and reduce their size, the previously mentioned thiols were added to the synthesis solution. This method ensures a high degree of purity and avoids chemical contaminants typically associated with conventional wet-chemical synthesis techniques. Following the synthesis, the NPs are linked to the RNA chains and coated in a lipidic bilayer in order to improve their biocompatibility and cellular uptake. These lipidic bilayers consist of a mixture of POPC (1-Palmitoyl-2-Oleoyl-sn-glycero-3-PhosphoCholine), cholesterol and DMG-PEG 2000 (1,2-DiMyristoyl-sn-Glycero-3-methoxyPolyEthylene Glycol), which results in a stable and biocompatible nanovector as showed in fig.1c. The physicochemical characterization of the NPs, alongside systematic evaluation of their stability, surface properties, and functional performance are performed. Subsequently, in vitro studies are planned to assess their biocompatibility, cytotoxicity, and potential as contrast agents for multimodal imaging. Furthermore, their theranostic capabilities will be investigated in the context of radiosensitization for X-ray radiotherapy, aiming to improve therapeutic outcomes in oncological treatments. This study presents an innovative approach to nanoparticle design, integrating advanced nanofabrication techniques with targeted biofunctionalization strategies to enhance precision medicine applications.^[5]

References

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Figures

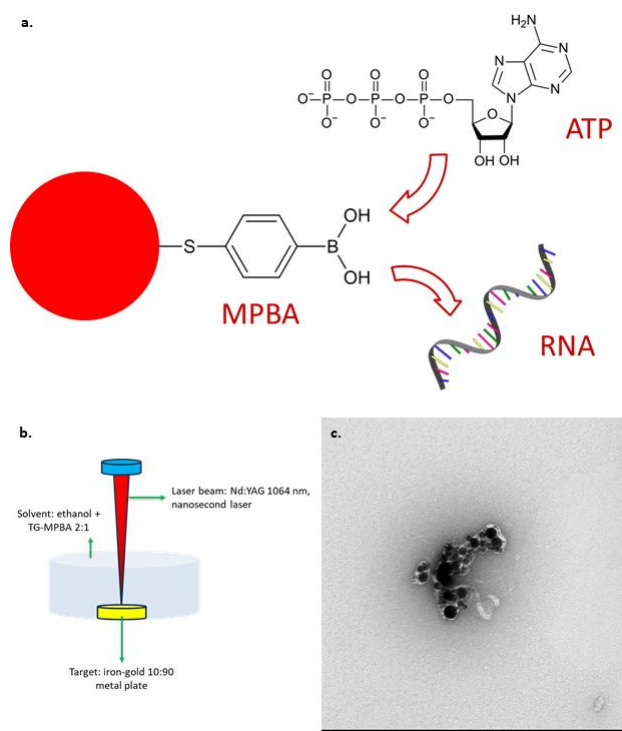


Figure 1. a) Idea of gene delivery through replacement by ATP molecules of RNA chains linked to MPBA-functionalized NPs by covalent bonds. b) General scheme of Laser Ablation in Liquid (LAL) technique. c) TEM image of AuFe nanoalloys functionalized with MPBA+TG and coated with the lipidic formulation based on POPC, cholesterol and DMG-PEG 2000.