Microfluidic Synthesis of Protein-Gold Nanoparticle Hybrids: Potential for X-Ray triggered drug release

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Zein is a class of prolamin proteins found in the endosperm of corn and is an attractive drug carrier for several reasons: its (1) biocompatibility, (2) renewable and abundant source, and (3) its amphiphilic nature. The amphiphilic nature of Zein allows the encapsulation of hydrophobic drugs and formation of nanoparticles (NPs) [1]. Our group has previously used microfluidics to produce these NPs in a robust and reproducible manner [2]. We are now examining the use of X-rays as an external trigger to release drugs from Zein NPs. The radiolysis of water by X-rays generates reactive oxygen species (ROS) which, under certain conditions, is enhanced by the presence of gold NPs. ROS are known to react with surrounding materials, such as DNA, proteins, and lipids, to degrade and destabilize their structure [3]. The destabilization of Zein NPs in this way could potentially be used to release drug on-demand with the application of X-rays. We present here, the design of Zein NPs that are destabilised by exposure to X-rays. We also show data indicating how the total X-ray dose, dosing schedule, and presence of gold NPs, impact the structure of Zein NPs. Overall, the presence of gold NPs and increase in applied total dose lead to a greater degree of protein modification in the Zein NPs. Interestingly, the dosing schedule, whether the dose was applied at a single time point or as smaller doses at multiple time points, was found to have no impact on the degree of modification of Zein NPs.


Figure 1: Schematic Representing the Formation and Radiation Induced Triggered Release of Zein NPs