Novel Red Blood Cell Membrane-Wrapped Septenary High-Entropy-Alloy Nanoparticles for Photothermal Osteosarcoma Treatment, Year 2

Damaraju, Laya (School: West Shore Junior/Senior High School)

As the field of cancer research increases, photothermal nanoparticles have become a forefront for localized cancer treatment. High-entropy-alloy nanoparticles, consisting of at least 5 alloyed metals, are promising photothermal therapy agents due to their high photothermal conversion abilities compared to traditional nanoparticles. To combat the low biocompatibility that characterizes most inorganic materials, membrane-wrapping the high-entropy-alloy nanoparticles with red blood cell membranes would allow camouflaging in the body to increase passive accumulation at the tumor site. It was hypothesized that the membrane-wrapped high-entropy-alloy nanoparticles would have higher photothermal conversion and passive accumulation in osteosarcoma cells. To test this, a novel nonequilibrium synthesis method was developed to increase efficiency and scalability of current methods. A short-pulse femtosecond laser was directed at an emulsion of hexane and aqueous metal precursors to reduce the metals and form nanoparticles. TEM characterization showed that high-entropy-alloy nanoparticles, FeCoNiCuPtPdAu, were synthesized ranging from 20-40 nm. UV-vis spectroscopy and photothermal heating tests showed that the FeCoNiCuPtPdAu nanoparticles exhibited high photothermal conversion, having a peak absorbance of 2.632 Au between 750 and 900 nm. and a temperature increase of 56.0℃ when irradiated for 30 minutes. By comparing this data to previous data collected on natural cephalopod ink nanoparticles, it is projected that the FeCoNiCuPtPdAu nanoparticles would have an at least 35% higher efficacy at photothermally treating the osteosarcoma cells. Membrane-wrapping the nanoparticles and cancer cell studies with osteosarcoma cells are being conducted to support this project's conclusion.