Presentation

Title and Abstract

Polymeric Nanobiomaterials with Extended Porosity: Strategic Payload and Co-Delivery for Therapeutic Applications

Achieving nanoporous bio-safe polymeric capsules is a big challenge in drug delivery applications. Synthesis of amino acid-based block copolymers and the development of nanoscale capsules with porosity is not an easy task. Extensive research work has been carried out on the synthesis of amino acid-based block copolymers and the development of nanoporous capsules with desired size and shape. Modified chemical synthesis and ring-opening polymerization methods were followed through the soft template approach to synthesize various block copolymers. The development of capsules with significant and superior qualities such as a wide range of porosity has been ignored and it's a grand challenge to the scientific community to develop nanoporous capsules with good cell viability and with minimum side effects. To address this, the current research work has been undertaken. The malignancy of lung cancer is driven by aberrant activation of epidermal growth factor receptor (EGFR)-tyrosine kinases, as well as the positive feedback loop between cancer cells and tumor-associated macrophages (TAMs). A programmed co-delivery system of Gefitinib (GFT) and miRNA-125b (miR125b) can be a synergetic strategy for lung cancer treatment to overcome the bottleneck issues posed by malignant cells and TAMs. Hence, we have designed a biomimetic, dual-targeting polymeric carrier using Chitosan (CS) as matrix and L-Arginine (L-Arg) as lateral chain, co-polymer [(CS)-*co*-(L-Arg)]. Upon decoration with Au NPs, [(CS)-co-(L-Arg)] transforms into a nest-typed, perforated nanoformulation of [(CS)-*co*-(L-Arg)]-(AuNPs), (CAAu), which integrates loading capacity with cationic property and is customized for construction of co-delivery nanosystem. CAAu based combinational nanomedicine is fabricated with GFT and miR125b. By exploiting the bio function of CS and L-Arg, GFT-miR125b@CAAu nanomedicine achieves the integration of lung specificity and tumor targetability. With pH-responsive release in the tumor microenvironment, GFT-miR125b@CAAu not only inhibits cancer cell survival by blocking the EGFR signaling pathway but also deactivates M2 TAMs by augmenting miR125b expression, by which GFT-miR125b@CAAu nanomedicine implements a synergetic therapy against lung cancer.

Future work:

As per global statistics, age and diabetes-associated chronic ulcers affect 6.5 million patients per year in the United States and 8.2 million across the world. Diabetic ulcerative wounds with uncontrollable bleeding and reconstruction are the main cause of death or serious complications in human beings. A major complication associated with chronic ulcerative wounds includes compositionally dysregulated and architecturally disorganized extracellular matrix (ECM), bacterial resistance, multidrug resistance (MDR), and its implications on wound healing. A nanomaterial with patterned architecture and anchoring capacity with ECM or wound tissue

can be a boon to leverage the wound healing process. Characteristic properties of Chitosan (CS) such as positive surface charge, biocompatibility, and biodegradability have made it a potential material for many biomedical applications. Similarly, hydroxyethyl cellulose (HEC) is a water-soluble polymer that has been widely used as a thickening agent for biopharmaceuticals and drug capsule preparation. Meanwhile, MXene ($MoZr_3C_2$) is proven a potential material for cancer treatment, wound healing, and cardiovascular myopathy. Presently, the MXene@Chitosan-based hydrogel with antibacterial activity and electrical stimulation (E-Stim) for wound healing can be a novel approach to leverage patients from chronic diabetic wounds.