Theranostics with Radiolabeled Nanomaterials

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Radiolabeled nanomaterials have gained tremendous interest over the last 2 decades, which can play diverse roles in imaging, image-guided drug delivery, as well as theranostics of a number of diseases such as cancer. Some recent examples of radiolabeled materials from our recent work will be briefly described in this talk.

Although chelator-based radiolabeling techniques (commonly used for labeling nanomaterials with radiometals such as ^{64}Cu/^{89}Zr) have been used for decades, concerns about the complexity of coordination chemistry, possible alteration of nanomaterial pharmacokinetics, and potential detachment of radioisotopes have driven the need for developing a simpler yet better technique for future radiolabeling.

The emerging area of intrinsically radiolabeled nanomaterials can take advantage of the unique physical and chemical properties of well-selected inorganic or organic nanomaterials for radiolabeling, and more importantly, offer an easier, faster, and more specific radiolabeling possibility to facilitate future clinical translation. Generally speaking, the four major categories of intrinsically radiolabeled nanomaterials include: 1) hot-plus-cold precursors, 2) specific trapping, 3) cation exchange, and 4) proton beam activation.

Representative examples of each category will be briefly illustrated in this talk, with the main focus on our own work that involves the radiolabeling of a variety of nanomaterials via “specific trapping”. The nanomaterials investigated in our laboratory include silica-based nanoparticles, carbon-based nanomaterials, DNA nanostructures, iron oxide nanoparticles, micelles, multifunctional/multimodal hybrid nanomaterials, among others.