Nanoparticle delivery agent for astatine

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Metallic nanoparticles are a potent and important area of study due to their applications in nanotechnology, medicinal technology, and surface alterations. Gold nanoparticles (AuNPs) are the most studied material for these usages [1]. These nanoparticles with targeting peptides have been commonly used for cancer treatment research due to their size and shape flexibility. The functionalization of the gold nanoparticles can be completed using various peptides that have the ability to bind specific receptors overexpressed on cancer cells [2]. This allows targeted delivery of the gold nanoparticles to cancer cells.

Targeted alpha therapy is a promising method of cancer treatment due to the alpha particles having a short range with large energies deposited [2]. Astatine has a short half-life with the decay scheme both resulting in alpha decay. Incorporating targeted alpha therapy onto a drug delivery agent such as gold nanoparticles, could advance the use of At-211 for medical applications. These structures are easily altered due to their variety of size, shapes, and surface functionalization, so the attachment of astatine needs to be studied to determine the most efficient method of usage.

Astatine is currently being produced via irradiation of a bismuth target with an alpha beam obtained from the cyclotron. The target is then dissolved in nitric acid, which results in astatine and bismuth in solution. Methods of separation of astatine from bismuth in this solution, and then possibly functionalized for radiolabeling, is being investigated with the use of AuNPs.

There are several methods to incorporate At-211 onto the gold nanoparticles. The first method can be to add a functionalization molecule that is likely to bind more to astatine than compared to the bismuth that is also in the solution. Astatine can also be bound onto the AuNPs directly, once it is in the reduced form. Currently both methods are being evaluated to understand the chemistry of astatine with medical complexes.

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