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SYNTHESIS OF MESOPOROUS SILICA NANOPARTICLES FOR TARGETED ALPHA THERAPY

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Although the development of cancer treatments is one of the most important fields in medicine, many of the traditional treatments, such as chemotherapy, result in devastating side effects. This has led to a growing number of studies looking into less developed treatments, such as targeted alpha therapy. Targeted alpha therapy delivers radioactive elements selectively to cancer cells and is an ideal treatment because the nuclear decay is contained to the site of the cancer, preventing harm to non-cancerous cells. This is a result of the alpha particle being trapped within a delivery vehicle, inhibiting it from circulating around the body. This project uses mesoporous silica nanoparticles as the vehicle to deliver the alpha particles. The research I have conducted focuses on the synthesis of the silica nanoparticles, while the portion of the project dealing with radioactive materials was performed at the Civil and Environmental Engineering Department. The primary goals of my project were to synthesize silica particles that were monodispersed, spherical, mesoporous, and have a diameter of less than 50 nanometers. To synthesize the nanoparticles, I've used the Stöber process or variations of the Stober process. This process is useful since it synthesizes silica in a controllable and uniform manner. Over the past several months, dozens of trials were tested. Although there was variation in specific details, this synthesis was generally performed by treating tetraethoxysilane (TEOS) solutions in water/ethanol with ammonia in the presence of CTAB at varying temperatures. The size of the nanoparticles was controlled by the concentration of the reagents, temperature, and rate of addition. All reactions were left to run overnight. The particles synthesized were collected the following day, washed in ethanol/water solutions, and their size and porosity were characterized using electron microscopy. After analyzing the particles, it was determined that they were of the appropriate size, indicating that the Stöber process was effective in this research. The best reaction conditions for this synthesis were performing it at 50°C and adding TEOS in a dropwise manner. These conditions allowed for the particles to grow to be approximately 30 nm in diameter. However, this research is still ongoing due to the fact that not all the trials have resulted in monodispersed particles. We have found that further altering reaction conditions, such as stirring rate, can solve this problem, so these methods will be tested in the future.