Halloysite Nanotubes with Polyelectrolyte Nano-coatings Embedded with Rifampicin

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Statement of Purpose: Halloysite nanotubes (HNTs) are two-layered naturally occurring aluminosilicate nanotubes.[1][2] Due to the surface charge of the HNTs, polyelectrolytes can be deposited on the surface of the tubes using layer-by-layer self assembly.[3][4] Previous studies have displayed low cytotoxicity, make it an ideal candidates for a novel drug delivery system.[5] By incorporating constructs composed of polyelectrolytes with a layer of drugs in the middle, a system can be created for effectively delivering multiple drugs into the body.

Methods: PSS/PDM multilayers were created on the HNTs using Layer-by-Layer self-assembly. Vials containing HNTs were filled with a solution of poly(sodium 4-styrene sulfonate) (PSS 1mg/mL). The vials were allowed to mixed for five minutes and centrifuged. After being centrifuged, the PSS solution was removed and replaced with a solution of poly(diallyldimethylammonium chloride) (PDM 1mg/mL). The vials were mixed for another five minutes and centrifuged. This process was repeated until the desired number of layers had been created. After the desired number of PSS/PDM layers had been crated, a series of polyvinylpyrrolidone (PVP)/poly(acrylic acid) (PAA) layers were created in the same manner as previously described with both solutions being 1mg/mL. After the desired numbers of layers were created a layer of Rifampicin (RF) was created using a solution of Rifampicin (1mg/mL) and the same method as described above. Following the creation of the Rifampicin layer, another series of PVP/PAA layers were created followed by a final series of PSS/PDM layers. A second set of constructs identical to the ones described above were created with the exception that after the drug was loaded, no layers would be created after. These served as the control for the experiment. The release characteristics of the constructs were examined using reverse osmotic water as the media. The results from the release study were analyzed using UV-Visible spectroscopy (RF- λ 241 nm).

Results: This study demonstrated that the constructs would contain the drug inside of the layers with little to no release as shown in Figure 1 with G2-1 being the control. At the start of the trial, a small amount of drug is released, however after the first sample, no drugs were found. When the constructs were degraded, the drug was released. Figure two shows the amount of drug retained within the system versus the amount of drug released during the trial after a continuous thirty-minute release with G2-2 serving as the control. The UV-Vis data shows that the RF is effectively contained within the constructs until the layers were degraded.

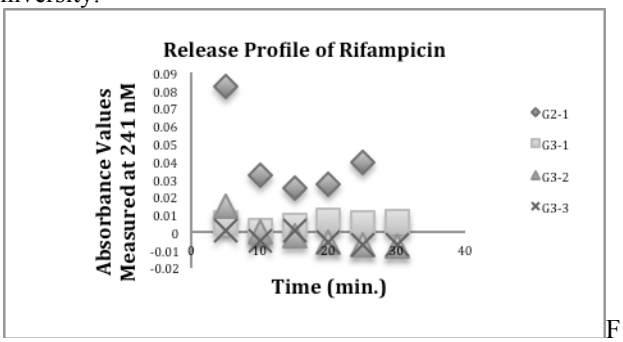

Figure 1. Release profile of samples loaded with Rifampicin with release over thirty minutes.

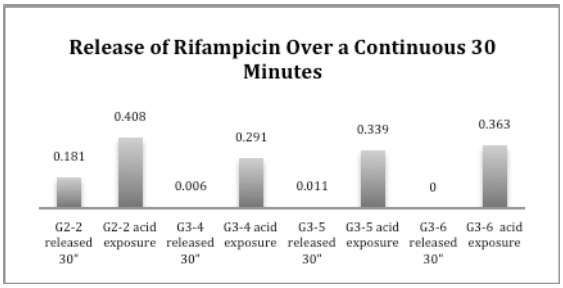

Figure 2. Release profile of samples loaded with Rifampicin released for a continuous 30 minutes followed by degradation of the layers. Values are absorbance at 241nm.

Conclusions: The aim of this study was to develop a construct on the outside of a HNT that would effectively contain the drug without it being released over time. These constructs are designed to be able incorporate a variety of drugs to create a customizable treatment option. In addition, it is believed that these systems can be modified to release at different triggers.

References:

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