4am Dry Powder Aerosols for Therapeutic Drug Delivery

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Pulmonary drug delivery has long been accepted as a valuable delivery route for small molecules. However, it has only been discovered in the last few decades that the lung also acts as a portal for therapeutic molecules, including the growing repertoire of relatively large proteins, peptides, and DNA-based therapeutics, to the systemic circulation. A significant challenge facing scientists and engineers today is the development of delivery systems that can target these drugs to the appropriate sites within the body to maximize drug efficacy, while providing a more patient-friendly non-invasive approach. The work presented here describes two novel dry powder aerosols useful for targeted delivery of therapeutics for local lung therapy or systemic action.

Dry powder aerosols offer improved control over physical properties necessary for proper targeting within the lung, the ability to easily modify particle surface properties (for improved dispersion or attachment of targeting moieties), and increased storage stability. Currently, in my postdoctoral work, we are developing new aerosol therapies for the treatment and control of inhaled infectious diseases, such as tuberculosis. Our goal is the rapid sterilization of the lung mucosa to quickly eradicate active bacterial populations, thus reducing the duration of infectivity and the duration of chemotherapy required for treatment. These systems represent a practical approach to combat or prevent outbreaks of TB and MDR-TB, and can be applied more broadly for other respiratory infectious diseases such as SARS and small pox.

Polymeric particulates provide controlled drug release and drug absorption that is extended over many days, while protecting the drug from degradation or premature clearance. In my doctoral work, we made progress toward a successful polymeric aerosol carrier through 1) the development of new poly(ether-anhydride) copolymers with appropriate properties for use as drug carriers in the lung; 2) a better understanding of the relevant physicochemical parameters that govern polymer particle aerosolization and deposition within the lung; and 3) a theoretical model and in vitro characterization method to guide rational particle design. Properly engineered polymeric aerosols could dramatically improve the way drugs are administered in the future, and may make certain drug therapies more affordable for people in resource-limited environments.

Collectively, this work provides improved technology platforms for the targeted delivery of therapeutics within the body for disease specific states and will aid the future development of aerosols for therapeutic drug delivery.