Design of a Smart Inhaler System for Improved Aerosol Drug Delivery

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Drug delivery via inhalation of drug aerosols has long been a standard procedure for the treatment of respiratory ailments. A number of researchers have explored the use of inhaled drugs as a novel way to administer new, often aggressive, drugs. However, conventional inhalers release medication uniformly in the mouth inlet. This approach leads to low inhaler efficiency characterized by high deposition in the upper oral airway. Kleinstreuer and Zhang (2003) have shown that a controlled release of drug particles at a specific location in the mouth inlet greatly increases drug efficiency and allows targeting of specific affected sites within the lung. The methodology was further validated experimentally using a fixed exit position nozzle/inhaler system and model airway/lung structure. Motivated by these results, this work presents the design and fabrication of a shape memory alloy-enabled (SMA) "smart inhaler system". Incorporating a flexible nozzle capable of moving the exit position to any desired location, the smart inhaler system will be a robust system capable of treating many patients. The system employs several novel techniques in the area of smart actuator design and implementation. Ref: Kleinstreuer, C., and Zhang, Z. (2003). Targeted drug aerosol deposition analysis for a four-generation lung airway model with hemispherical tumors, ASME Journal of Biomechanical Engineering, 125(2), 197–206.