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Using Magnetic Nanoparticles in a Static and Dynamic Magnetic Field to Penetrate Model Mucus[1] MEGHAN SMITH, AUSTIN ROUTT, UCCS Biofrontiers, EVANGELOS ECONOMOU, UCCS Physics, GUY HAGEN, UCCS Biofrontiers, VIRA KRAVETS, UCCS Physics, ZBIGNIEW CELINSKI, KATHRIN SPENDIER, UCCS Biofrontiers and UCCS Physics — Current asthma treatment options are often hindered due to inefficient drug delivery methods through the thick layer of mucus lining the lungs, thus inhibiting inhaled medication from reaching underlying inflamed tissue. This project tested magnetically guided Dextran Sulfate Sodium (DXS) coated iron oxide, Fe_3O_4, nanoparticles (FeNPs) and Carbomethyl Dextran (CMD) coated barium hexaferrite, $BaFe_{12}O_{19}$, nanoparticles (BaNPs) as a drug delivery system through model mucus. A high magnetic field gradient was generated using a permanent neodymium magnet with an iron core pole piece to pull the magnetic NPs through a 2.5 cm layer of hydroxyethyl cellulose (HEC) gel. Additionally, Helmholtz coils produced an oscillating magnetic field to physically rotate the magnetic NPs. The penetration time of FeNPs and BaNPs through HEC gel was measured as a function of oscillation frequency. For a frequency range of 0 to 1900 Hz, the data illustrated penetration time of BaNPs is functionally dependent on oscillation frequency whereas penetration time of FeNPs showed no correlation. These BaNPs have large magnetic anisotropy fields allowing them to physically rotate and open holes through the HEC gel contrasting FeNPs which simply change magnetization without rotation.

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