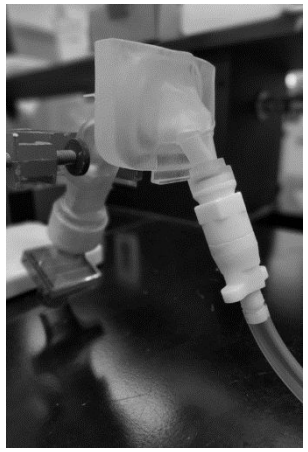
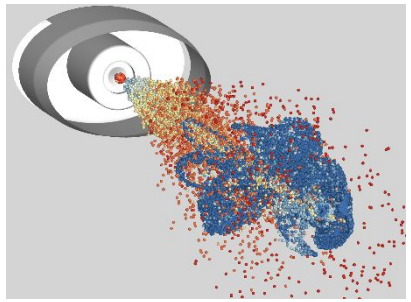
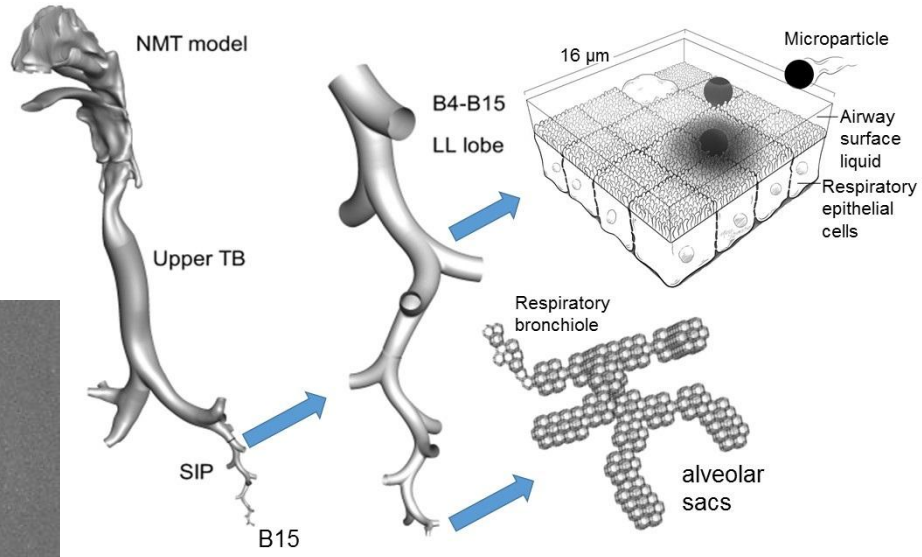
Research Trust 4:
Health-Related Aerosols

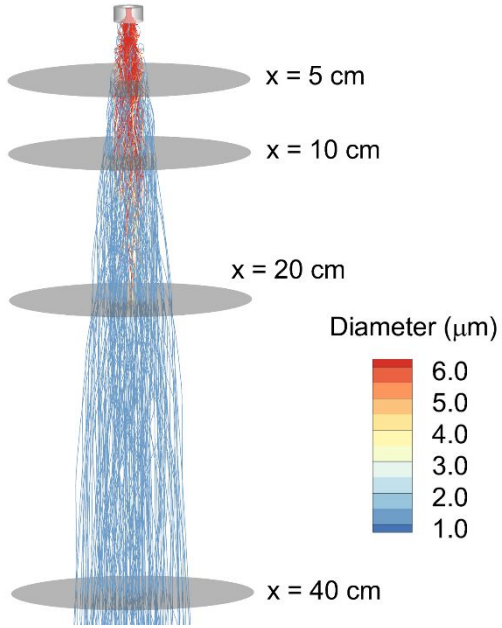
This thrust researches and develops the scientific knowledge and technology which can either solve the issues encountered in medical practices or improve the performance and functions of medical devices, related to aerosol particles. The major research areas include (but not limited to) respiratory deposition of inhaled aerosols; particle technology for drug delivery; medical device coating; design and testing of personal protection equipments (PPEs); and environmental aerosol exposure and risk assessment.

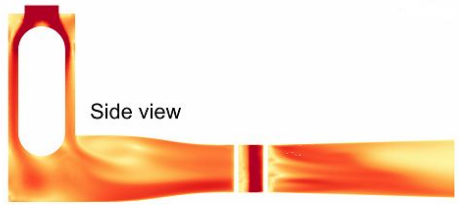
Heath Related Aerosols - Image

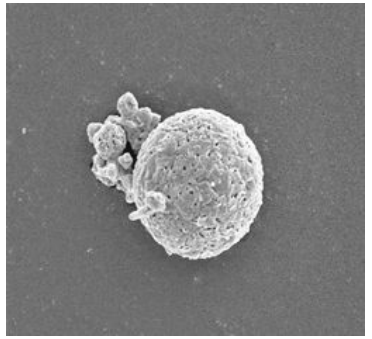


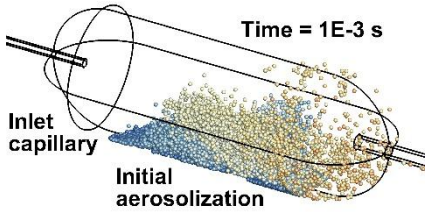


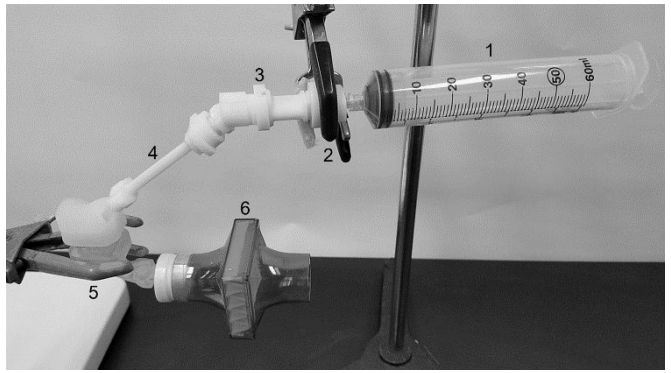




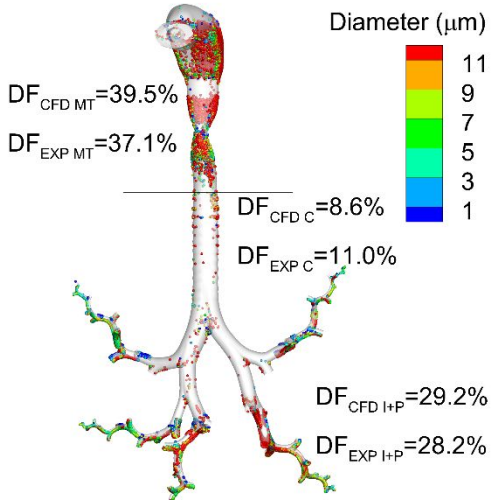








Respimat (PIFR=41 LPM)

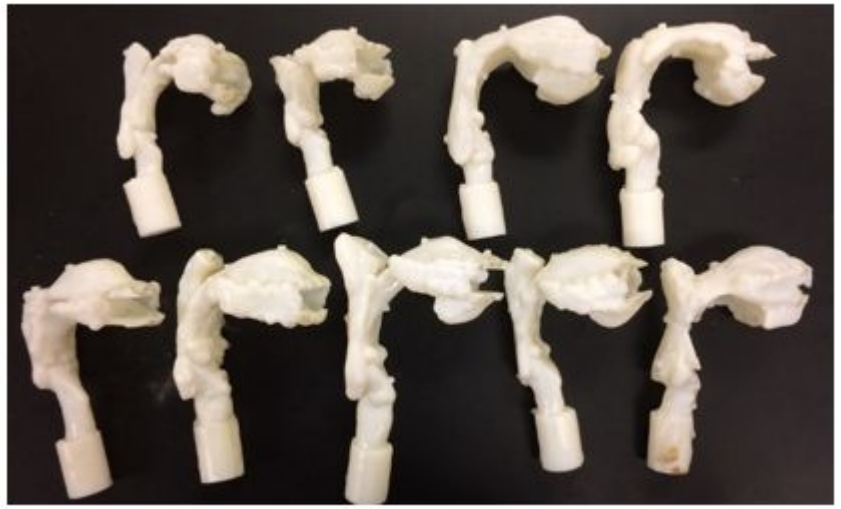


Respiratory Deposition of Aerosols: In Vitro

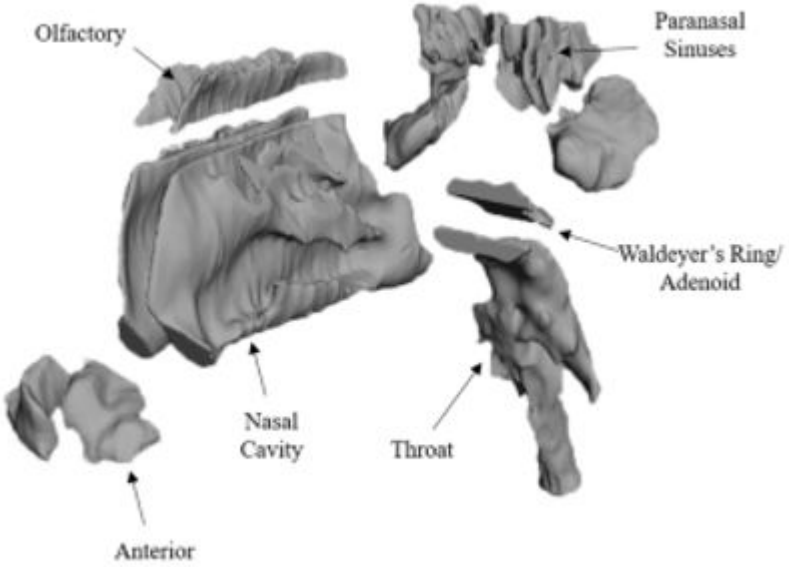
- Nasal Drug Delivery
  - Vaccines
  - Local-acting drugs

Hosseini et al., JAMPDD (2019): 32(6): 374-386.

- Mouth-Throat Models to develop and evaluate:
  - Pulmonary drug delivery
  - Electronic Nicotine Delivery Systems

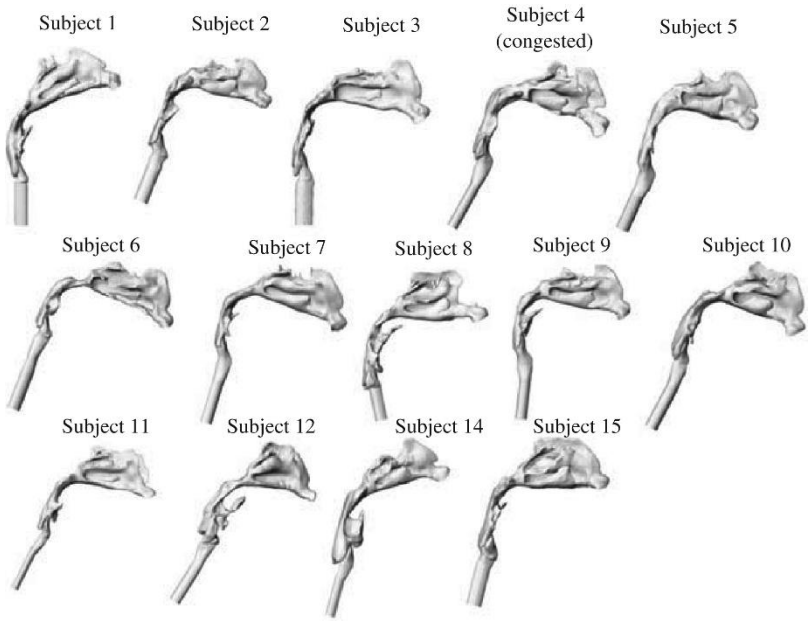


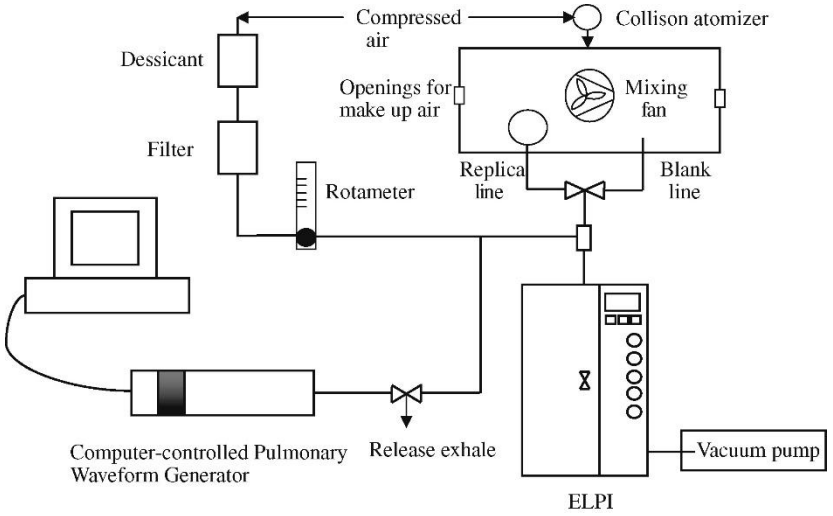
Golshahi et al., JAS (2012) 49: 21-31.



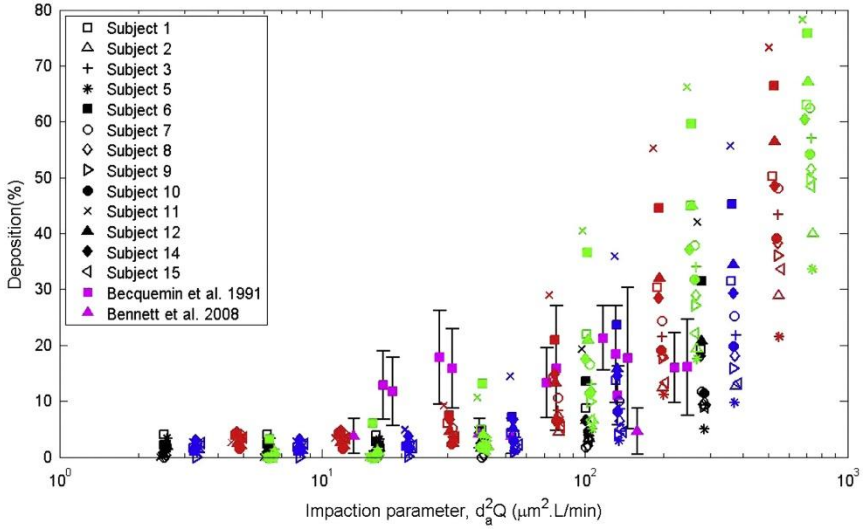
Wilkins et al., Pharm Res (2021): 38(1): 141-153.

Environmental Aerosol Exposure Assessment

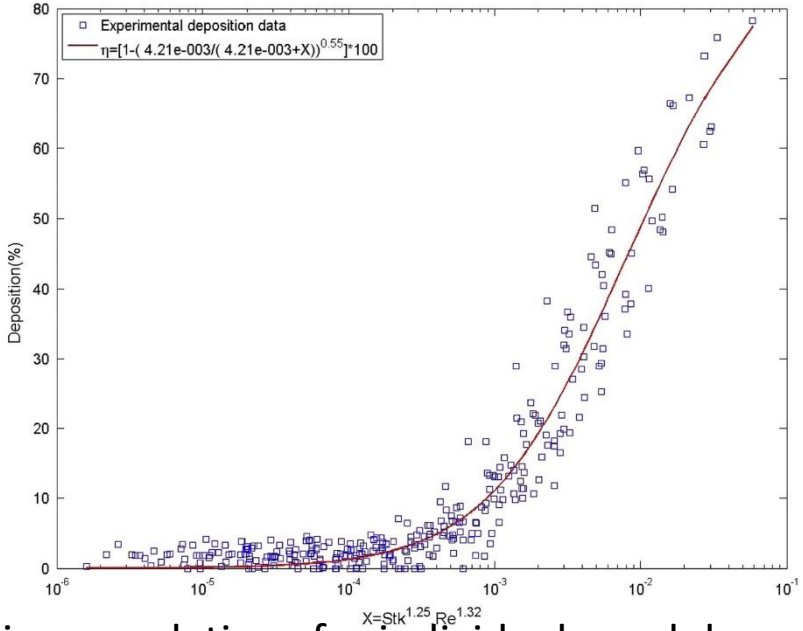




Golshahi et al., JAS (2011) 42(7): 474-488

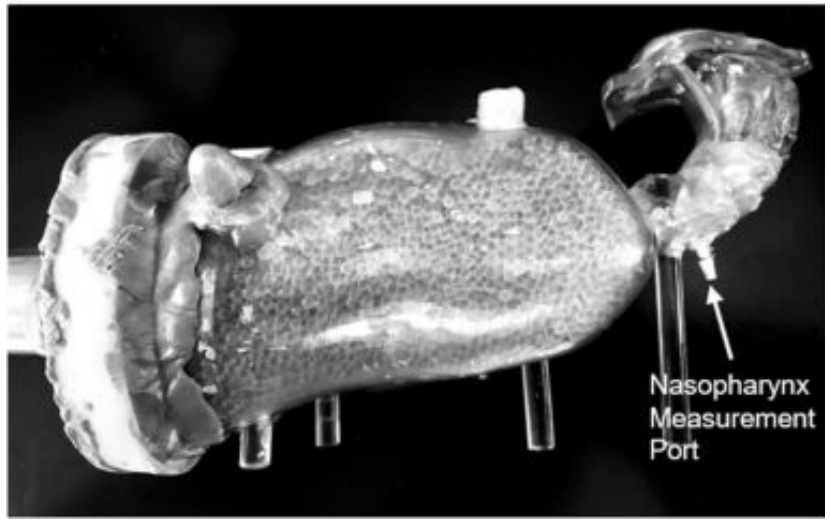


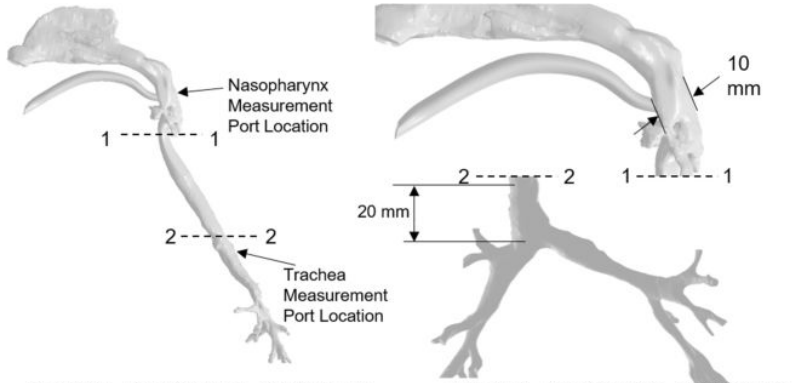
Intersubject variability in nasal deposition in children

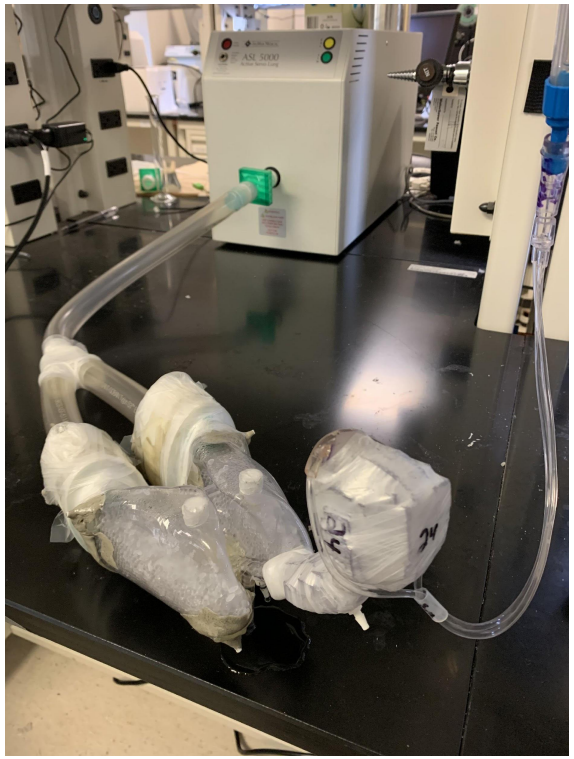


Predictive correlations for individual nasal deposition in children

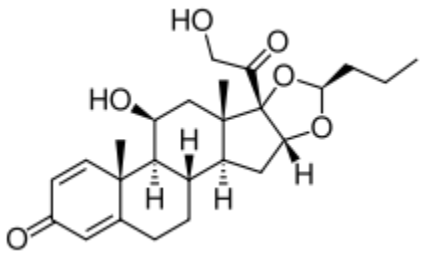
Innovative Technology for Gas and Drug Delivery



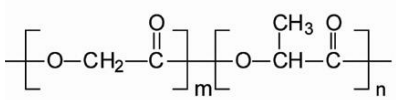




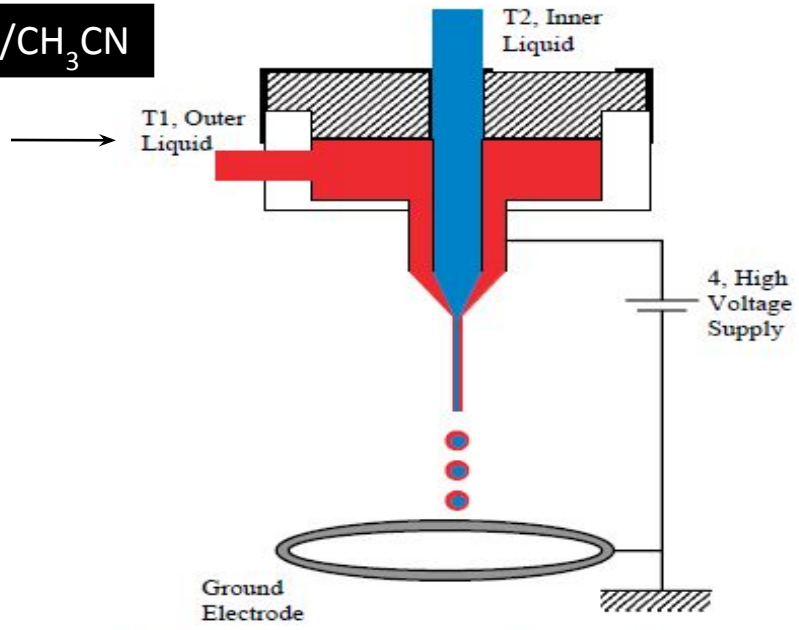
Characterization of PLGA-coated Budesonide Particles

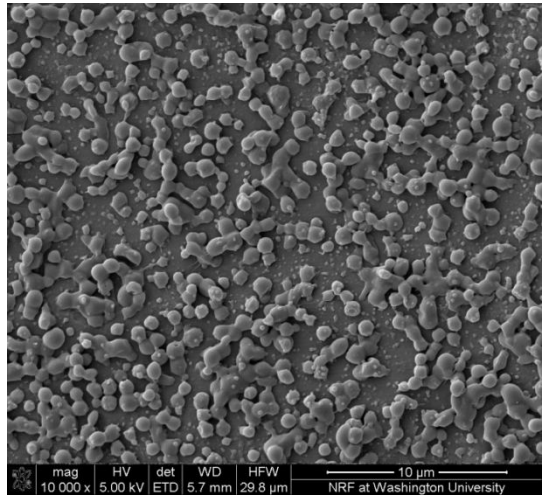


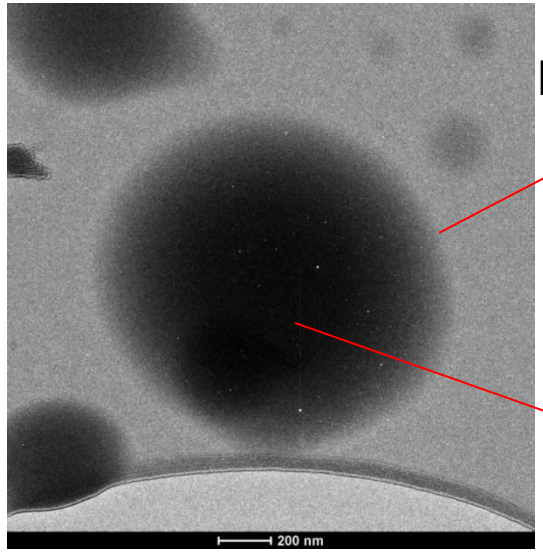
Drug solution
Budesonide/EtOH



PLGA/CH_3CN



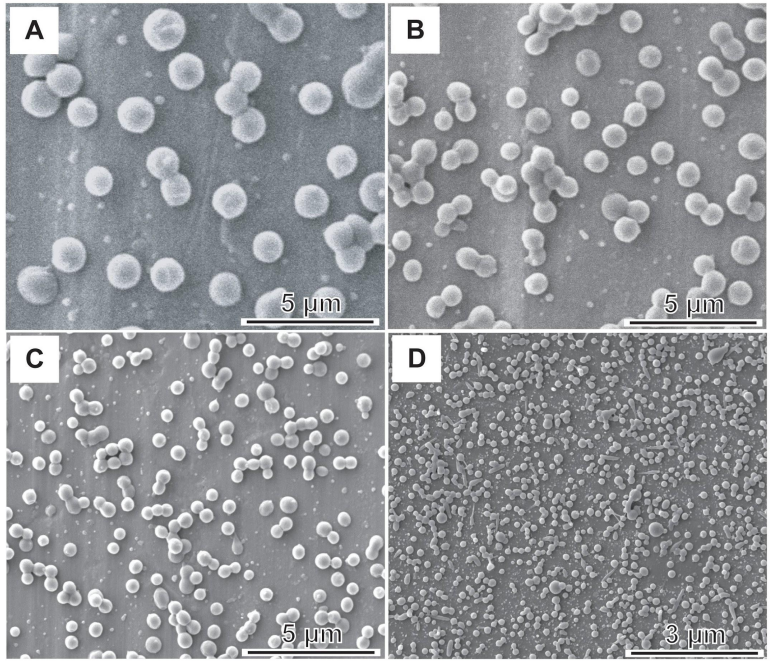


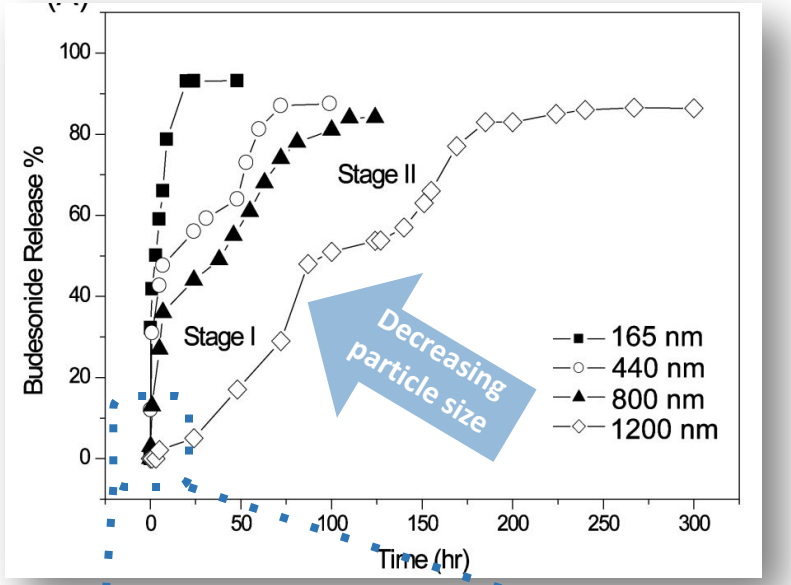


PLGA shell

Drug

Release Profile Characterization





Preventing Initial burst release

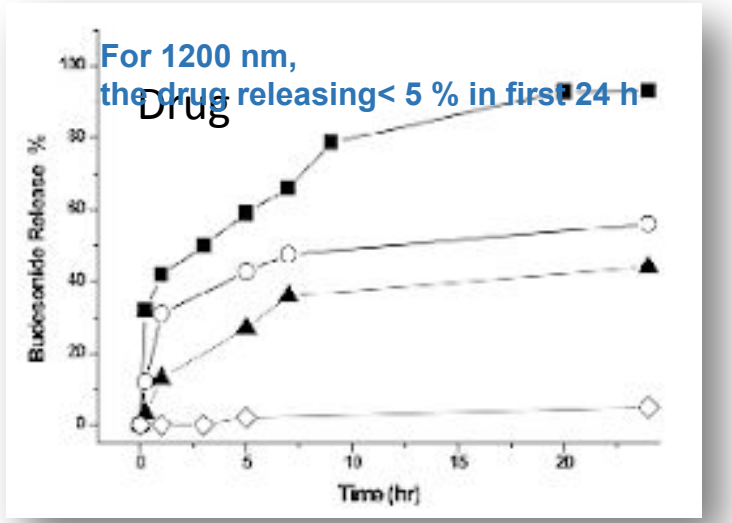
Two advantages:

- Control the release profile by particle size
- The core-shell structure prevent initial burst release

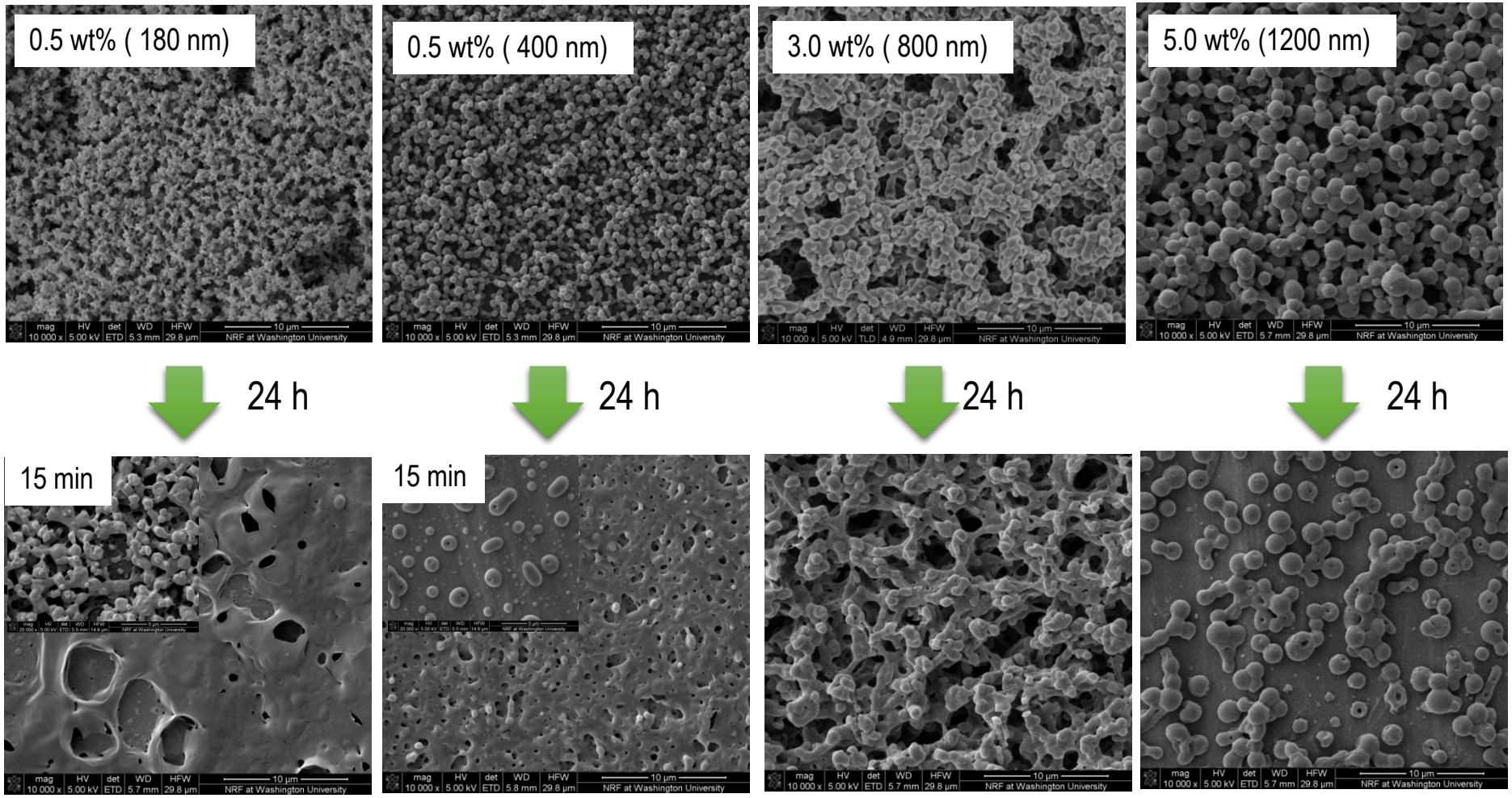
ES particle

Emulsion particle

Surface loaded drug resulting initial burst release

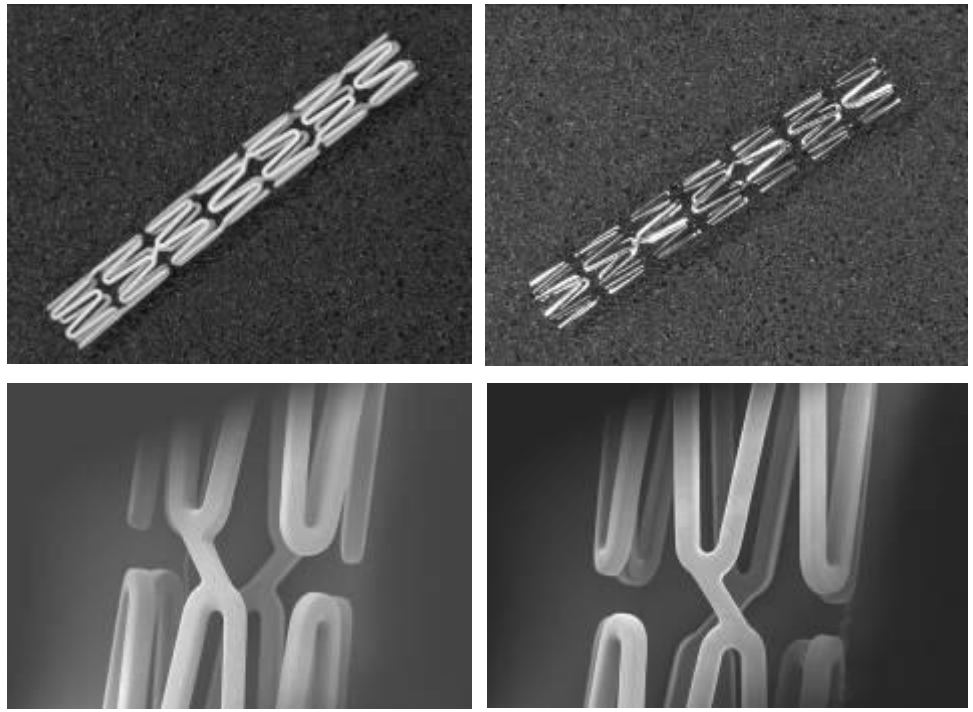


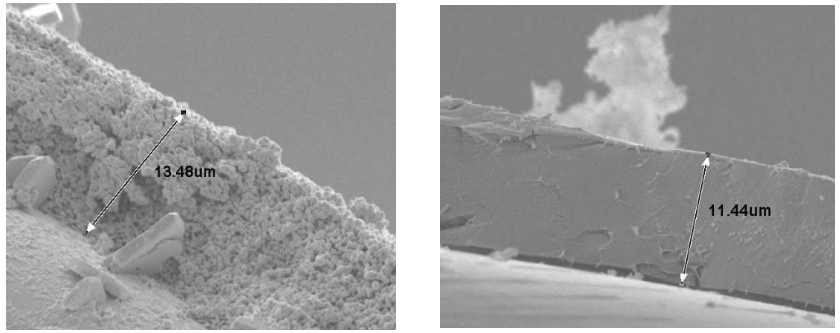
Degradation of PLGA Spheres of Different Sizes



Electrospray for Stent Coating Process

- Non-line-of-sight spray process delivers “wrap around” coating with consistent surface features
- Multiple active agents may be incorporated into nanocomposite matrix
- Overcomes limitations of conventional spray and dip coating

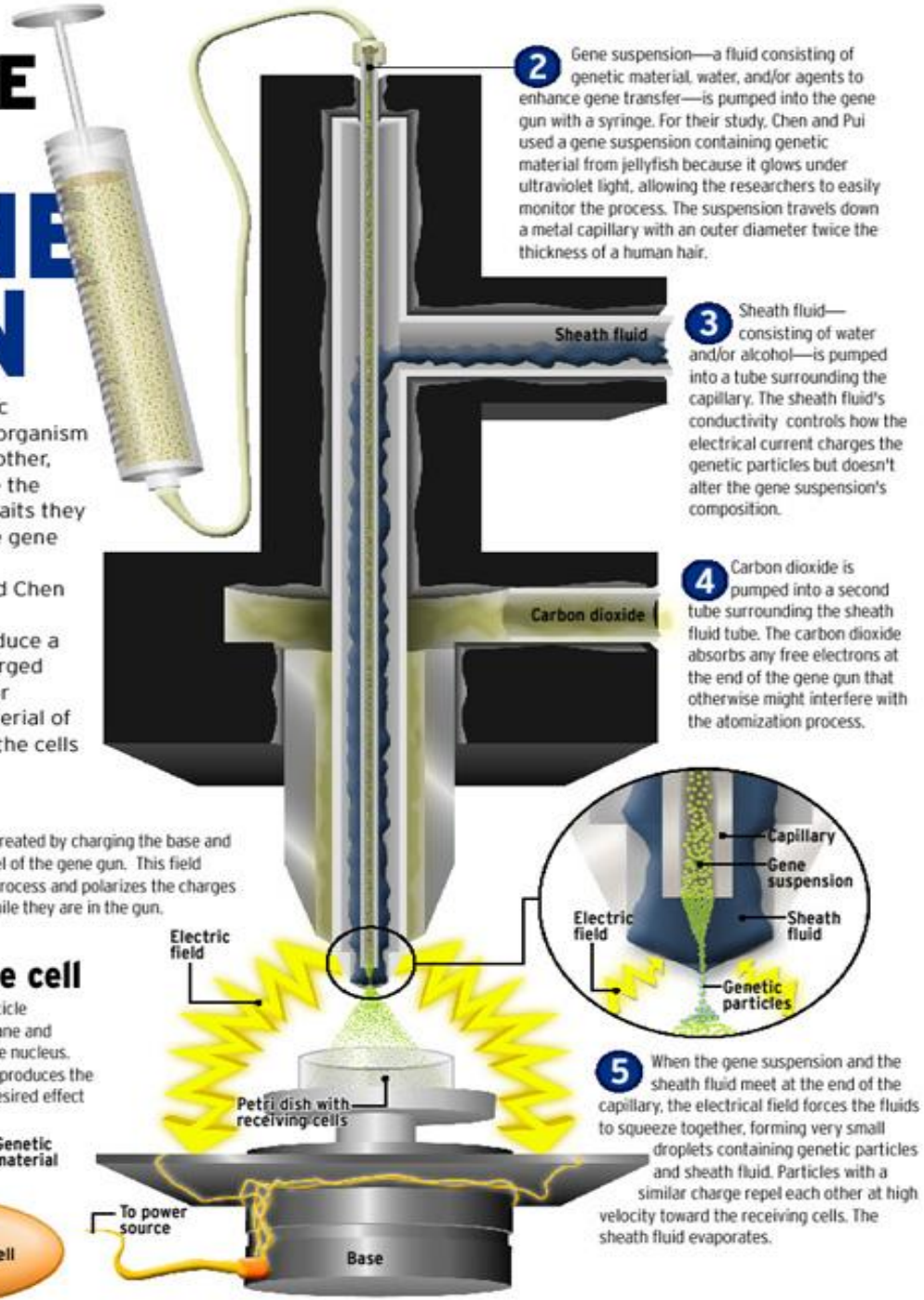




Coating matrix uniform throughout stent surfaces

INSIDE THE GENE GUN

By inserting genetic material from one organism into the DNA of another, scientists can force the genes to express traits they normally don't. The gene gun developed by researchers Pui and Chen uses electrostatic atomization to produce a cloud of highly charged genetic particles for "shooting" the material of one organism into the cells of another.



2 Gene suspension—a fluid consisting of genetic material, water, and/or agents to enhance gene transfer—is pumped into the gene gun with a syringe. For their study, Chen and Pui used a gene suspension containing genetic material from jellyfish because it glows under ultraviolet light, allowing the researchers to easily monitor the process. The suspension travels down a metal capillary with an outer diameter twice the thickness of a human hair.

3 Sheath fluid—consisting of water and/or alcohol—is pumped into a tube surrounding the capillary. The sheath fluid's conductivity controls how the electrical current charges the genetic particles but doesn't alter the gene suspension's composition.

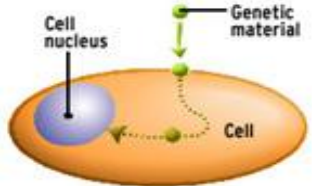
4 Carbon dioxide is pumped into a second tube surrounding the sheath fluid tube. The carbon dioxide absorbs any free electrons at the end of the gene gun that otherwise might interfere with the atomization process.

1 An electric field is created by charging the base and grounding the barrel of the gene gun. This field controls the atomization process and polarizes the charges of the genetic particles while they are in the gun.

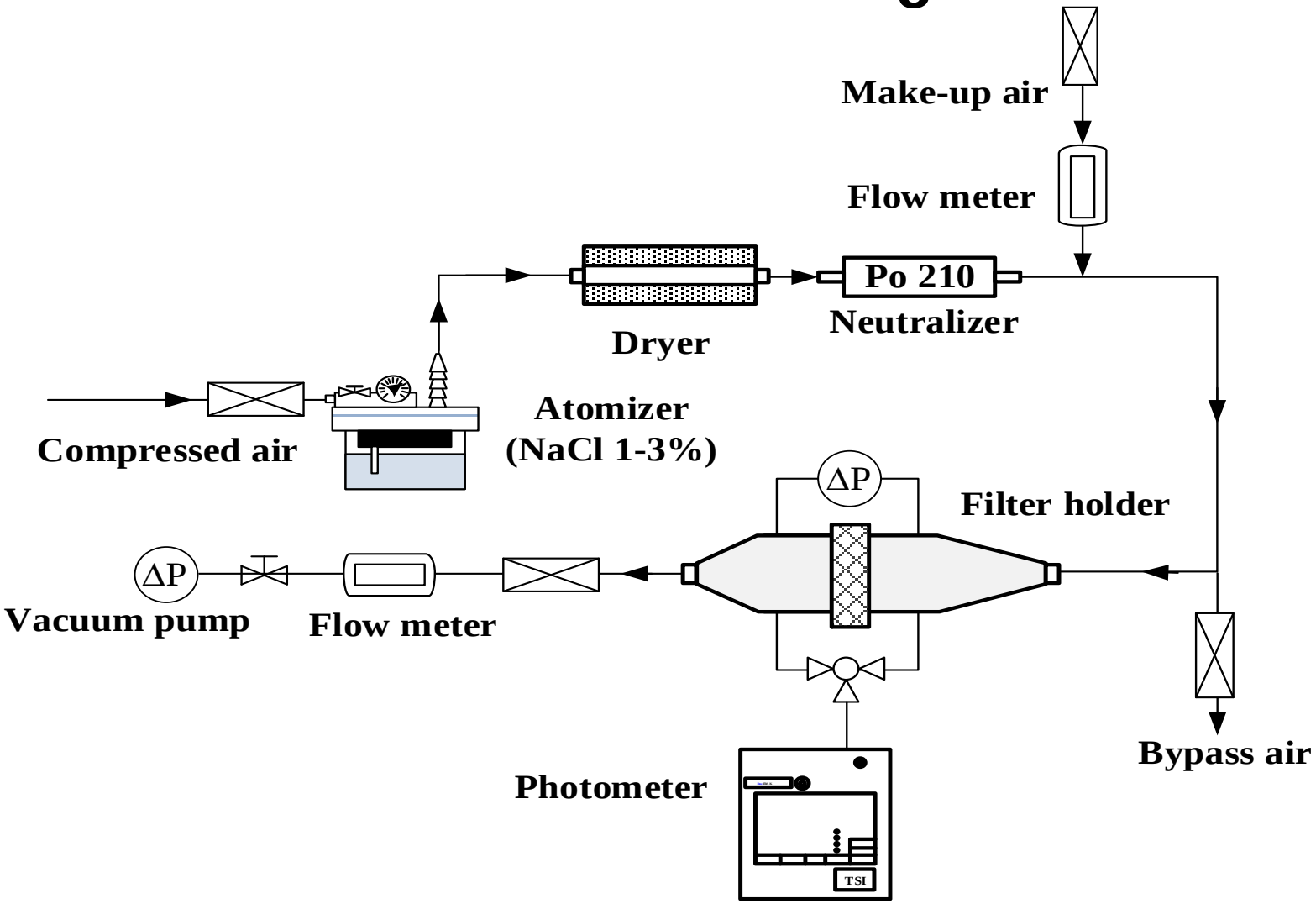
5 When the gene suspension and the sheath fluid meet at the end of the capillary, the electrical field forces the fluids to squeeze together, forming very small droplets containing genetic particles and sheath fluid. Particles with a similar charge repel each other at high velocity toward the receiving cells. The sheath fluid evaporates.

6 Inside the cell

A fast-moving genetic particle punctures the cell membrane and subsequently travels to the nucleus. There, the DNA eventually produces the proteins that create the desired effect within the cell.



N95/KN95 Test Rig



$$\eta(\%) = \left(1 - \frac{C_{downstream}}{C_{upstream}}\right) \times 100\%$$