Design of an Enhanced Cellular Model for the Assessment and Tracking of Nanomaterials

Maggie Jewett

Advisor: Kristen K. Comfort, Ph.D.

Department of Chemical and Materials Engineering, University of Dayton

Rationale

- There is currently a poor correlation between *in vitro* and *in vivo* studies.
- The need for a better model is needed to further comprehend the body's response without human testing.

	In vitro	*In vivo*
Pros	• Fast • Inexpensive	• Closer correlation to human exposure
Cons	• Non-realistic exposure routes	• Expensive • Time consuming • Ethical issues

Figure 1: The pros and cons of *in vitro* and *in vivo* studies

Background

- Human cell model: A549 alveolar epithelial, HepG2 liver epithelial, HaCaT skin keratinocyte, and U937 monocyte
- Due to their unique properties, silver nanoparticles (AgNPs) are utilized in consumer and medical products.
- AgNPs are known to induce cellular stress and cytotoxicity in mammalian cells.
- *In vitro* and *in vivo* studies have been conducted separately but never together.

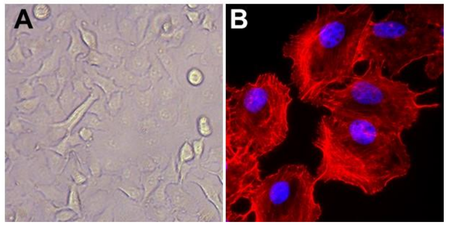

Figure 2: Images of A549 cells taken via (A) light and (B) fluorescence microscopy

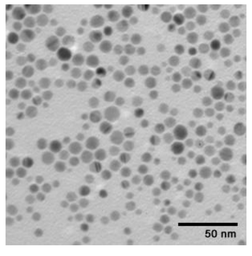

Figure 3: TEM image of the 10 nm AgNPs

Objectives

- The goal is to design, optimize, and implement an enhanced microenvironment model (EMM) to bridge this *in vitro – in vivo* gap.
- Creating an *in vitro* model that better represents an *in vivo* model would allow for more accurate results without human or animal testing.
- Incorporates *in vivo*-like variables of:
  - Dynamic movement
  - Multi-cellular system with an immune component
  - 3-Dimensional implementation

Approach

- Cellular responses will be collected and analyzed following specified exposure conditions to AgNPs through:
  - MTS cell viability analysis
  - Reactive oxygen species (ROS) levels
- Dynamic circulation and perfusion of culture medium within a multi-welled plate using a reinnervate perfusion plate and multi-channel cassette pump.
- Transwell inserts have the potential to incorporate a 3-Dimensional aspect to the model.

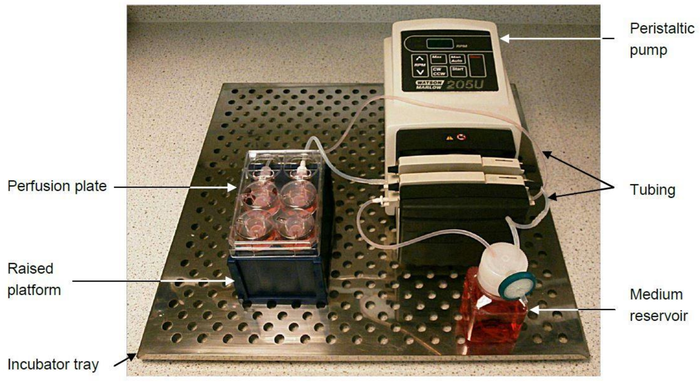

Figure 4: Dynamic circulation with perfusion plate connected to multi-channel cassette pump for dynamic flow

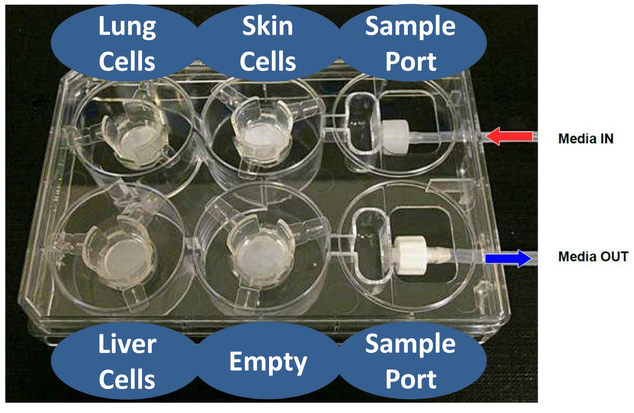

Figure 5: Perfusion plate with projected cell culture ports connected with dynamic flow