**Department of Materials Science and Engineering**

**PhD Thesis Proposal**

**June 20, 2018, 2:00 PM**

**Bossone 302**

# Evaluation of Adhesion of Pharmaceutical Powders to Tooling Components in Cold Powder Compaction

**Henrietta Tsosie**

**Advisor: Dr. Antonios Zavaliangos**

## Abstract

Cold powder compaction is used in many industries including powdered metal and ceramic parts where a green compact is achieved through compaction then sintered. In other industries such as food, cosmetic, and pharmaceutical, green compacts with a range of mechanical properties are produced. The tablet is the most common form of drug delivery for many reasons including ease of administration, patient compliance, stability, and lower manufacturing and distribution cost. A common concern in pharmaceutical development is the propensity for powder to adhere to the tooling components, also known as *sticking*. It is clear that this problem involves the fundamentals of material adhesion and the basic mechanisms of this phenomena are not well understood.

The objective of this proposal is to develop an experimental-theoretical-numerical approach to establishing a scientific framework for the problem of particle adhesion. In this presentation, I will review some basic concepts as well as prior work in the literature on this problem. Current work focuses on new approaches of understanding particle adhesion with the main goal of developing methods that (a) can effectively assess sticking, (b) experimentally determine processing parameters that affect sticking, and (c) develop design guidelines and processing maps for rational decision making based on our methods. Preliminary results will be presented from scanning electron microscopy observations of the adhered powders on the surface of punches and their implications will be discussed. Additional results from tests conducted using an adhesion punch and a heated punch will also be presented. Finally, some new ideas including the manipulation of the cohesion branch of particle-wall and particle-particle contacts using a new cohesive elastoplastic model in discrete element modeling will be discussed.

A scientific framework based on materials science and applied mechanics for the problem of powder adhesion in pharmaceutical tableting will be developed for the first time. This work will elucidate the mechanisms involved, the role of material parameters, and the local mechanics of this problem. In turn, this work will further computational tools that can aid in tooling design to reduce adhesion and develop techniques that will assess the early onset of sticking.