Lab project / internship M1 PPN-QuanTEEM (1,5 months : 15/05-30/06)

2022-2023

Title of the project: Multiscale Approach to Adhesion during Pharmaceutical Compression

Supervisor(s): Pr. Eric LESNIEWSKA, Dr. Eric BOURILLOT

Laboratory / Department / Team : ICB UMR CNRS 6303 / Dept. NANOSCIENCES / NanoSense Lab

Collaborations: Powder ON (Dijon Metropole)

Summary: The proposed project aims to advance the state of the art and knowledge in the manufacturing of pharmaceutical by the matrix compression process. Thanks to a coupled experiment / numerical simulation approach, the aim is to propose an innovative methodology for the study of this process in order to achieve a better understanding of the phenomena contributing, during the process, to the development of cohesion within of the tablet with the objective of better understanding and predicting the performance of the final product.

This project plans the study, at the microscopic level, of the interaction between the grains in order to understand, characterize and correctly model the adhesion that is created between the particles by taking into account the deformations under stress during the compression / decompression cycle in connection with the macroscopic characterization of the tablet. A numerical approach will make it possible to formulate and implement different mechanical constitutive laws, both with regard to the viscoelastic and viscoplastic deformations generated by the compression and the resulting adhesion between the grains. The numerical method envisaged is the modeling by multi-particulate finite element method (MPFEM) which makes it possible to couple the elastoplastic behavior of the particles with the possible viscous effects and to account by realistic models of the development of adhesion at the level of the contacts.

The goal of this internship is to achieve realistic experimental tests, both at the particle scale and at the scale of an elementary volume representative of the tablet.

Other particulate elements (such as graphene) could be used in order to understand the compression of grains.

Scanning Microwave Microscopy (SMM), Atomic Force Microscopy (AFM) and related spectroscopic modes will be used to characterized at nanoscale the interaction between grains, the strain profile on different tablet design.

The development of a “digital twin” type modeling tool would constitute a definite advantage for the competitiveness of pharmaceutical tablet manufacturers, in an economic and societal context of the relocation of health product manufacturing activities to our territories.

Type of project (theory / experiment): Experiment

Required skills: Motivation