The Summer Undergraduate Research Fellowship (SURF) Symposium
3 August 2017
Purdue University, West Lafayette, Indiana, USA

Microstructure evolution during compaction of powder blends

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ABSTRACT

Powder compaction is a manufacturing technology used to transform powder particles into a solid material with unique anisotropic microstructure and low porosity. It is widely used by pharmaceutical companies to manufacture tablets with desired properties. These properties are the result of the microstructure obtained during the compaction process. Therefore, it is imperative to understand the mechanics underneath the constituent granular particles that eventually contribute to properties of the manufactured tablets. Computational simulation tools have been developed in the past to study powder compaction for pharmaceutical tablets. However, most of the already existing tools limit their scope to study individual particles and their interactions with adjunct particles or surfaces. Moreover, they treat powder bed as a continuum body. A study of compaction of powder blends with specific particle size distributions would better elucidate evolution of microstructure during compaction in pharmaceutical tablets. In our study, we introduce a new version of nanoHUB powder compaction tool. We use static based algorithm to place binary mixture of polydisperse particles inside a die. We have also included nonlocal approach of contact mechanics to accurately predict interactions between particles. This approach makes our method computationally less challenging and precise. Inclusion of binary mixture of particles of different sizes in the computational tool allows users to study relationship between particles' mechanical properties and their microstructure evolution during compaction process. Users can also validate their experimental/expected results for deformations of binary mixtures of elastic or plastic particles from those obtained from simulation tool.

KEYWORDS

Powder compaction, Nonlocal contact formulation, Packing of particles, Particle mechanics approach, Powder blends