MSE-307: Principle of Powder processing of materials

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Mechanical methods

1. It is the cheapest of the powder production
2. These methods involve using mechanical forces such as:
   I. compressive forces,
   II. shear forces
   III. impact forces

to facilitate particle size reduction of bulk materials; Eg.: Milling

3. Milling: During milling, impact, attrition, shear and compression forces are acted upon particles.
4. During impact, striking of one powder particle against another occurs.
5. Attrition refers to the production of wear debris due to the rubbing action between two particles.

6. Shear refers to cutting of particles resulting in fracture.
7. The particles are broken into fine particles by squeezing action in compression force type.

Main objective of milling:

I. Particle size reduction (main purpose),
II. Particle size growth,
III. shape change,
IV. agglomeration (joining of particles together),
V. solid state alloying,
VI. mechanical or solid-state mixing,
VII. modification of material properties

Mechanism of milling:

1. Changes in the morphology of powder particles during milling results in the following:
    a) Microforging,
    b) Fracture,
    c) Agglomeration,

d) Deagglomeration

Microforging: Individual particles or group of particles are impacted repeatedly so that they flatten with very less change in mass

Fracture: Individual particles deform and cracks initiate and propagate resulting in fracture

Agglomeration: Mechanical interlocking due to atomic bonding or vande Waals forces

Deagglomeration: Breaking of agglomerates

2. The different powder characteristics influenced by milling are:
   1) shape,
   2) size,
   3) texture,
   4) particle size distribution,
   5) crystalline size,
   6) chemical composition,
   7) hardness, density,
   8) flowability,
   9) compressibility,

10) sinterability,
11) sintered density

3. **Milling equipment:** The equipment are generally classified as crushers & mills