00A_Sintering

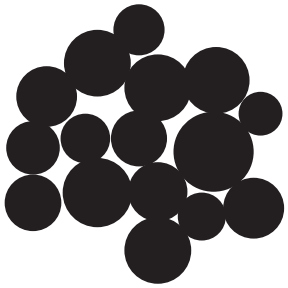
•Art, discovery, science, and technology

Ceramic objects date back to thousands of years. They were made with clay. Playing with clay to build objects is a human instinct. Play leads to art. Thus, history affirms that the earliest forms made from clay were expressions of our artistic and spiritual imaginations. Perhaps the earliest example is a four-and-a-half inch tall figurine, shown on the right, dating back to 26,000 years.

•Geometry - net shape process

Sintering is a net-shape process. The shape is expressed in the "green body". It shrink uniformly in all directions to yield a final object which is exactly of the same shape as the green body. This is a laboratory phenomenon.

The science of sintering involves understanding the structure of the green body and its evolution into a dense shape. The green body may be only 50% dense since it is made by packing of powders, whereas the dense body in nearly fully dense. How does it evolve from initial to the final state.



Note in the figure just below the grains in contact are etched with the mass being transported into the pore. In this way the particles move closer together while the pores are filled

Length scales:

Particle size: 10 nm up to 1μm , d

Pore Size: related to the particle size , αd where alpha<1. The length scales can be coupled.

Mechanism by with the porous structure can evolve into a dense structure.

The mechanism is the transport of atoms from the areas of contact into the pores.

The above concept is develop purely from geometry.

The distance of mass transport is related to the particle size/pore size.

The next steps are to understand how mass can flow in the way (kinetics) and what is the driving for this nature of mass transport.