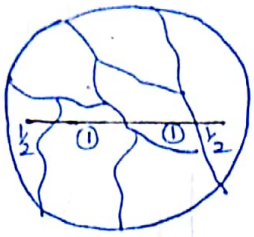
Nano Material:- $\leq 100\,nm$

Grain density:-



$\frac{1}{2}+1+1+\frac{1}{2}$

= 3 grain/meter

Yield strength — Hall patch eqn

$$Y.S. = \sigma_0 + \frac{k}{\sqrt{d}}$$

d = size of grain.

* when either one of physical dimension or the max. grain size is equal to or less then equal to 100nm it is called a nano material
* Because of very fine grain structure material will have larger surface area that is very prone to Reaction and at very high temp. since grain boundary have tendency to flow so material will exhibit a great degree of ductility.

Application:-

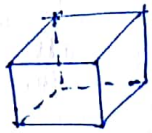
① Due to the larger contact area there will be uncontrolle combustion of solid fuel and these nano fuels are used in rockets and missiles.
② Bio medical engineering = artificial bones
③ Nano material honey comb catalytic converter)
④ Computer chips, Sunscreen lotion(TiO_2)
⑤ HD TV's → resolution will be better.

Classification :-

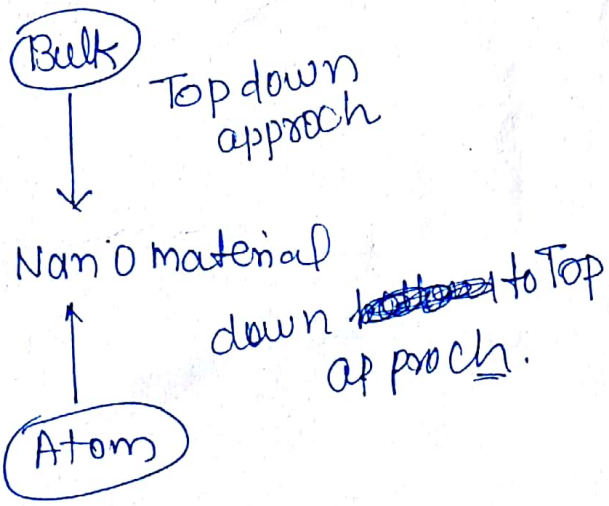
① **Zero Size :-** some of the example in this catogary are particle, Cluster of particle and diameter of this particle will be less then 100nm,

② **one dimensions :-** e.g. Nano tube used in artificial bones 

③ **Two dimension :-**
e.g. Thin Films

④ **3-dimension :-**  Any bulk material max. grain size < 100nm

Processing of nano material / How to manufacture nano material ?



* when the bulk material converted in nanosize particle it is called Top down approach. and
* when atom of any material synthesized and grouped together to produce nano material is called down to top approach

Methods

(top to down)

① Mechanical Grinding :-

→ hardened steel ball

if the material is extremely brittle we can directly put into the drum and when there is little bit ductility. Initial it will be dipped in liquid nitrogen and placed in drum. By the repeated collision between the material and steel ball material will convert in nano power but is it is a time consuming process.

down to top

② sol gel – hydrolysis ③ chemical vapour deposition

These are down to top approach and different atom are synthesized to convert into nano material