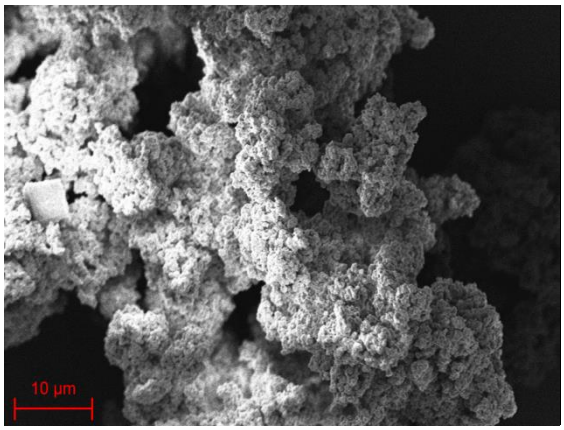
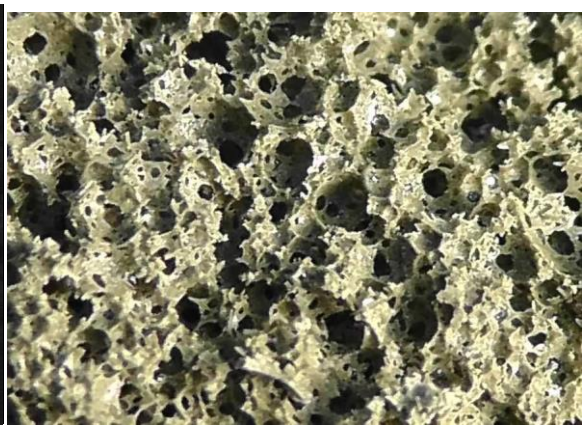
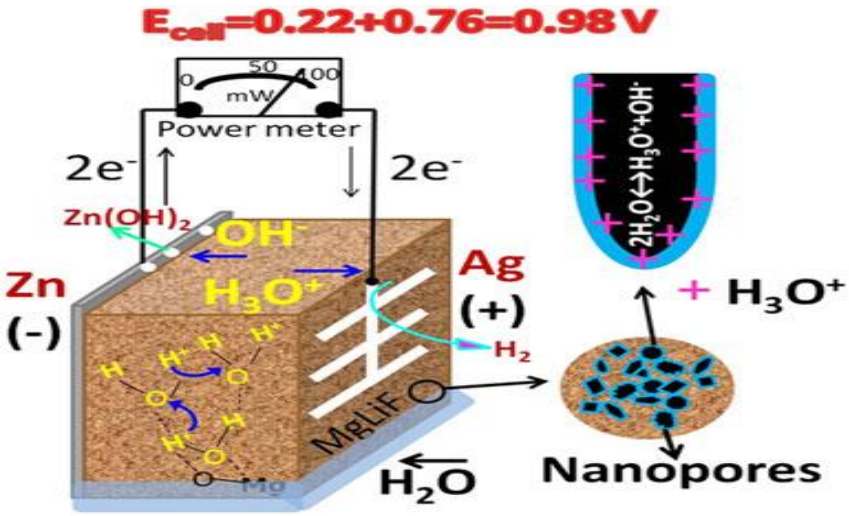
Porous Materials and their importance in various area of Science, Engineering and Technology

General Introduction





SEM- images of Macro porous materials **SEM of acoustic cement, concrete**



Natural porous materials used for water purification as water filter

General introduction

Materials having ordered or irregular arrangement of pores with different sizes from nanometer to millimeter are called porous materials. These pores may be cavities, channels may be in shapes of open Cylindrical , Cylindrical blind, ink-bottle-shaped, funnel shaped and roughness. The distance between two opposite wall of the pore is called size of the pores. While porosity is the ratio of total volume of the pore to the apparent volume of particle or powder. The detectable of accessible area of solid surfaces per unit mass is called surface area. Porosity and Hydroelectric cell – A boon of Nanotechnology in Ferrite magnetic nanomaterials.

Size of the porous materials

The size of pore are very important for various applications. There are mainly three kind of porous materials, Microporos, Mesoporous and Macroporous. Porous materials, whose size is below 2nm is microporous, size lies between 2nm to 50nm is called mesoporous materials and while porous material size above 50nm are called macroporous materials.

Some Applications

One of the uses in Impact energy adsorption, air and water permeability, acoustical properties, low thermal conductivity Energy absorbing systems, porous electrodes, sound absorbers, filters, insulating materials, heat exchangers, construction materials, electromagnetic shielding, membrane and membrane support.

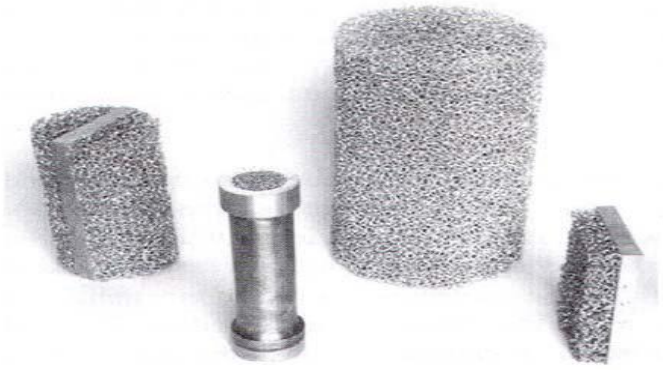


Figure 6-5. Aluminum foam components for different applications.

Heating effect on structure of porous materials

Powder sintering or loose powder sintering produces porosity. Annealing/ Sintering produces contacts between grains. Decompose or evaporate during sintering may give porosities may be up to 90%. In fibre technology coated by a low-melting agent to improve bonding. The structure may be ordered or randomly oriented. Electrochemical, PVD methods may be used. Capillary forces are the main reason for collapse of the gel during drying.: Strengthen the network and/or Modify the contact angle between liquid and solid causes modifying the surface and variation of solvent properties. During the sintering process, the thermal energy generates a force that drives the grain boundaries to grow over pores, thereby decreasing the pore volume and increasing the density of the materials . Thus properties of materials found to change.

Zeolite as natural porous materials

Zeolites are porous, hydrated aluminosilicates. They may be natural minerals or synthetic materials. The general chemical composition of a zeolite is is Mn, Si and Al with water molecules.*(: Mnx/nSi1-xAlxO2 · yH2O, Where M = e.g. Na+, K+, Li+, Ag+, NH4 +, H+, Ca2+, Ba2+).* The main characteristics of Zeolite are- three dimensional structure built from tetrahedral, containing pores and voids. Their structure and porosity is periodic (i.e. crystalline materials), pores have molecular dimensions. In the voids and pores are also water molecules, called Zeolite water.

One measure of the porosity is the amount of adsorbed water. The water molecules are also present in the pores and voids, and may (in many cases) be removed by heating and re adsorbed at lower temperatures.

Adsorption as molecular sieve hindi meaning Chalanee

Adsorption in zeolites is significantly different from adsorption in silica gel or active coal, which have a broad size distribution of pore sizes, and where the size of the pores are in the range of 10 nm. In zeolites the porosity is determined by the crystalline structure, i.e. the pores are arranged in a regular fashion with only one (or a few) discrete pore sizes. Also the pores have molecular dimensions. The implication of this is the use of zeolites as adsorbants and molecular sieves. Molecular sieving effect due to size limitation imposed by framework structure using cation size and position. A large increase in synthesis of zeolites was seen after 1940 when X-ray diffraction became a common characterization tools tool for structural analysis.

Functional groups incorporated into porous materials

Functionalizing porous materials is important for many applications. Functionalization may be done by introducing guest species in the pores, attached to the walls or by building functionality into the walls. E.g. dyes or biomolecules, catalysts, optical active molecules, functional organic groups (e.g. adsorption). Molecules may be introduced by adsorption, by co-synthesis (templates), “ship-in-a-bottle” synthesis, condensation (covalently attached) by grafting, or co-condensation.

Porosity and antimicrobial properties

surface exhibited in macropores, microporos and mesoporous with . Recent research sulfonic acid (-SO3H) groups were introduced on surface of materials that exhibited antibacterial performances and also in stem shell research particulary in bone treatment

Nanobacterium is a nano-organism that synthesizes a shell of calcium phosphate to cover itself, and resembles an inorganic particle .The shell ranges in size between 20 to 300 nm, and due to its porous nature it allows the flow of a slimy substance. This slime (presumably together with electrical charge) promotes the adhesion to biological tissues and the formation of colonies.