

Arindam Indra

Place of study: IIT Bombay, Mumbai, India

Nationality: Indian

Degree: Pursuing Ph. D.

A4.4

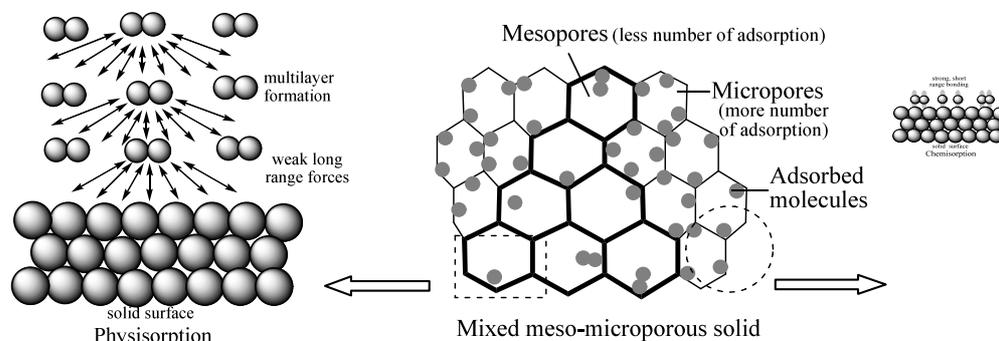


Figure 1. Physisorption and chemisorption on mixed meso-microporous solid.

According to IUPAC definition micropores have the dimension of less than 2 nm whereas mesopores have the dimension of 2-50 nm.¹⁻³ Though the filling of the pores largely depends on the size and shape of the adsorbates, in case of micropores, the whole accessible volume is regarded as adsorption space. The high adsorption potential inside the micropores increases the amount of adsorbed molecules compared to mesopores (Figure 1).⁴⁻⁶

Determination of the adsorption isotherms is very important for the characterization of porous solid. The isotherm shown in Figure 2a is particularly followed by microporous solids having relatively small external surfaces, for which the limiting uptake is governed by accessible volume rather than the internal surface area. The isotherm reaches a limiting value as the monolayer coverage approaches 1. This is the criteria of chemisorption as it strictly followed to the monolayer adsorption.⁷⁻⁸

The isotherm 2b depicted the monolayer formation followed by the filling of the pores and observed for the mesoporous materials.⁷⁻⁸

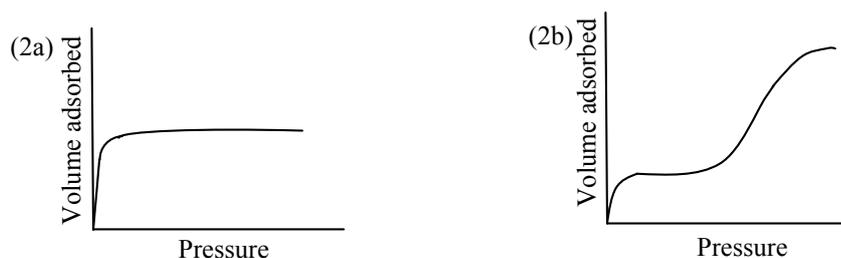


Figure 2. Adsorption isotherm for (a) monolayer adsorption in microporous solids and (b) monolayer adsorption followed by pore filling in mesoporous solids.

As shown in Figure 1, physical adsorption takes place when a molecule is adsorbed on the surface with weak, long range van der Waals forces (e.g. London, dispersion, polarization) and the bond energy is less than 10 kcal/mole. Physisorption takes place between all molecules on any surface providing the temperature is low enough, achieved equilibrium relatively quickly. Increasing temperature always reduces surface coverage.⁹

Chemical bonding involving orbital overlap and charge transfer (Figure 1) is called chemisorption. Chemisorption can be activated, in which case equilibrium can be slow and increasing temperature can favour adsorption and surface reactions often takes place.⁹

Q4.a. Answer:

Yes it is true that molecules undergo chemisorption only until a monolayer is formed and multilayer chemisorption is not possible generally. Tunneling assisted multilayer chemisorption is reported on Si surface.¹⁰

Q4.b. Answer:

Infinite numbers of layers of molecules can be adsorbed on the solid surface by physisorption at the temperature absolute zero.⁹

What do you think about this answer?

References

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