Sublimation Encyclopedia Article

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The transition of molecules from the solid phase into the vapor (or gas) phase is called sublimation.

At temperatures below the freezing point of a substance, the transition between solid and liquid phases (melting) does not generally occur. However, the direct transition from the solid to vapor phase does take place. For instance, wet clothes will freeze solid at temperatures below 32°F, but the clothes will become dry by sublimation without the ice melting. Another well known example is the evaporation of dry ice (solid **carbon** dioxide).

Sublimation can be understood on the basis of molecular behavior. In the solid phase, the molecules do not possess translational **energy**, e.g., they do not move around. The attractive forces between molecules have succeeded in causing the molecules to arrange themselves into fixed, ordered patterns relative to each other. They do, however, possess vibrational energy, with the molecules vibrating about their fixed centers of gravity. From time to time, individual molecules at the surface of the solid become energetic enough in their vibration to break the attractive hold their neighbors have on them and escape into the gas phase. Thus, sublimation occurs. A solid confined in a container will reach a characteristic equilibrium **vapor pressure** at a given **temperature**. Since the vibrational energy which the molecules of the solid phase possess depends on the temperature, they have more energy at higher temperatures and thus may escape more readily. The equilibrium vapor pressure will thus increase as the temperature increases.

Virtually all **solids** sublime to some extent. The aroma of solids (e.g., soap, chocolate) results from the interaction of our nasal sensors with molecules of the substance that have escaped into the vapor phase. Substances with very low vapor pressures, such as **metals**, generally do not have detectable aromas.