P. G. semester 2nd semester — Dr. V. Kumar

Topic : Ultracentrifuge

The ultracentrifuge is a centrifuge optimized for spinning a rotor at very high speeds, capable of generating acceleration as high as 1000,000 g (approx 9800 km/s²).

There are two kinds of ultracentrifuges (a) Preparative and (b) Analytical ultracentrifuge

History

Theodor Svedberg built a centrifuge in 1924 capable of generating 7,000 g (at 12000 rpm) and called it the ultracentrigue

Modern ultracentrifuges are typically classified as allowing greater than 100,000 g. Svedberg won the Nobel Prize in chemistry in 1926 for his research on colloids and proteins using the ultracentrifuge.

The Vacuum ultracentrifuge was invented by Edward Greydon Pickels in the Physics department at the university of Virginia in 1946.

Instrumentation

ultracentrifuges are available with a wide variety of rotors suitable for a great range of experiments. Most rotors are designed to hold tubes that contains the sample. swinging bucket rotors allow the tubes reorient to the horizontal as the rotor initially accelerate. Fixed angle rotors are made of a single block of material and hold the tubes in cavities bored at a predetermined angle. Zonal rotors are designed to contain a large volume of sample in a single contin cavity rather than in tubes.

Preparative rotors are used in biology for pelleting the fine particulate fractions, such as cellular organelles (mitochondria, microsomes, ribosomes) and viruses. They can also be used for gradient separations, in which the tubes are filled from top to bottom with an increasing concentration of a dense substance in solution. Sucrose gradients are typically used for separation of cellular organelles. Gradients of caesium salts are used for separation of nucleic acids.

After the sample has spun at high speed for sufficient time to produce the separation, the rotor is allowed to come to a smooth stop and the gradient is gently pumped out of each tube to isolate the separated components.

Hazards

The tremendous rotational kinetic energy of the rotor in an operating ultracentrifuge makes the catastrophic failure of spinning rotor is a serious concern. Rotors conventially have been made form high strength to weight metals such as aluminium or titanium.

The stresses of routine use and harsh chemical solutions eventually cause rotors to deteriorate. Proper use of the instrument and rotors within recommended limits and careful maintenance of rotors to prevent corrosion and to detect deterioration is necessary to migrate this risk.

More recentally some rotors have been made of light weight carbon fiber composite material, which are upto 60% lighter, resulting in faster acceleration rates. Carbon fiber composite rotors also are corrosion-resistant, eliminating a major cause of rotors failure.

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