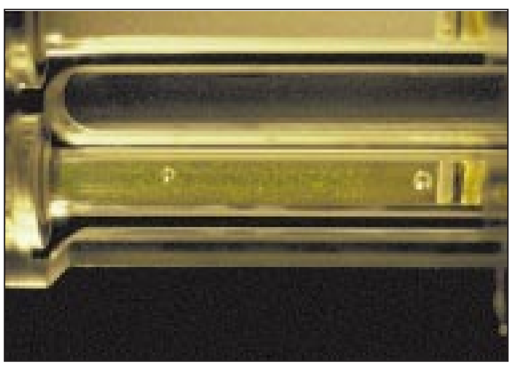
STS-95

CGEL-2: Structural Studies of Colloidal Suspensions

A colloid is a system of fine particles suspended in a fluid. Paint, ink, milk, and orange juice are some common examples. Though these products are routinely produced and used, scientists know little about the underlying structure of colloidal systems. Understanding their structures may allow scientists to manipulate the physical properties of colloids — a process called "colloidal engineering" — for the manufacture of novel materials and products. Colloid research may even improve the processing of known products for the enhancement of desirable properties.



Colloid sample from the first CGEL experiment during the STS-84 mission to Mir *in May 1997*

Colloid samples are difficult to study in ground-based laboratories because gravity causes dense particles in liquids to settle to the bottom of a container. In a microgravity environment, the effects of gravity are dramatically reduced, and the particles in a colloid disperse evenly. This equilibrium state is very important for establishing the true structure and properties of colloidal systems. In addition to the problem of settling in Earth-based studies of colloids, some colloids are unable to maintain their structure, and they collapse under their own weight. Researchers are hoping to discover if this collapse is indeed due to the effects of gravity or to other processes inherent to the structures formed.

The second Colloidal Gelation (CGEL-2) experiment on STS-95 will further colloid research through the study of three kinds of colloidal systems: binary alloy colloids, colloids plus polymers, and fractal colloidal aggregates. Binary alloy colloids are suspensions of particles of two different sizes in a liquid. Researchers suspect that a colloidal system containing different-sized particles may behave differently than one containing particles of a uniform size. In samples of binary alloy colloids for CGEL-2, both particles will be of the same acrylic-type material. Suspensions of a colloid with an added polymer can form colloidal aggregates, or gel-like structures. Studies of colloid-polymer samples for CGEL-2 will help researchers determine the behavior of different gel-like structures. The third type of colloid to be studied in the experiment is a fractal colloid aggregate. These systems are composed of two different kinds of particles suspended in a liquid. During the experiment, researchers will look at three different salt solutions: one containing polystyrene particles, a second containing gold particles, and a third containing silica particles.

In orbit, all three types of colloid samples will be mixed to evenly distribute the suspended particles, which are then allowed to sit for several days. During this interval, particles in the samples will organize themselves (i.e., self-assemble) into crystal-like and gel-like arrangements. Laser light will be used to gather structural information about the samples. The light will be directed at the samples and scatter as it is reflected off the surface of the crystalline

Flight hardware for the CGEL-2 experiment. From left to right: the experiment module, which is used to obtain light scattering data for the colloid samples; the Loose Parts Box, which contains a combination tool that allows astronauts to combine two fluids on orbit; and a laptop computer, where light scattering data are correlated and stored.

structures, revealing the placement of particles in the colloids. Observations of the properties resulting from particular structures can then be made. With this information, researchers will develop models to predict the structures and properties of different kinds of colloidal suspensions. The ability to predict a material's characteristics could result in decreased product development time and may lead to more efficient manufacturing. Industries using semiconductors, electro-optics, ceramics, and composites are among those that may benefit from colloid research. In a previous investigation onboard the Russian space station, *Mir*, in May 1997, researchers obtained photographs that revealed phase behavior of colloids and new crystallization mechanisms never before seen in ground-based studies.

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