

§17. Advanced Particle Transport Diagnostics with Tracer-encapsulated Pellet

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The essential point of this diagnostic is based upon the poloidally and toroidally localized particle source as a tracer within a small volume of about 1 cm^3 in the plasma. The tracer-encapsulated pellet consists of a small core as a tracer of light atom such as Li and the outer layer made of the different material from that of the core. A device for producing a Tracer-Encapsulated Cryogenic PELlet (TECPEL) is constructed as shown in Fig. 1 for an accurate transport diagnostic system to measure particle transport both in parallel and in perpendicular to the magnetic field lines on magnetic confinement devices.

As a typical configuration of TECPEL, a carbon sphere with a diameter of $240 \mu\text{m}$ is encapsulated in the center of a 3 mm diameter cylindrical form of solid hydrogen. There are a pile of tracer spheres in the storage device to be loaded. The typical number of the stored spheres is 20. One core tracer pellet is supplied automatically by the tungsten wire. Such a TECPEL is accelerated by a light gas gun to velocities of 400 - 800 m/s. The pellet has been photographed simultaneously from two directions, and a 3D image is reconstructed from two 2D images as shown in Fig. 2. The 3D image shows the existence of the carbon sphere in the adequate location inside the hydrogen pellet. Thus, the proof-of-principle of device operation has been demonstrated. The scheme to encapsulate the other light atoms such as Li, Be, B, and so on as a tracer is also proposed for the variety of experiments. The above materials can be made in a spherical form in principle, but such process is not always practical. So, the better

scheme to handle the even irregular shape and/or easily reacting materials is invented. The concept is based essentially on the technique to cover these non-sphere material with polymer such as polystyrene. There are two options based on this concept. These methods are being developed.

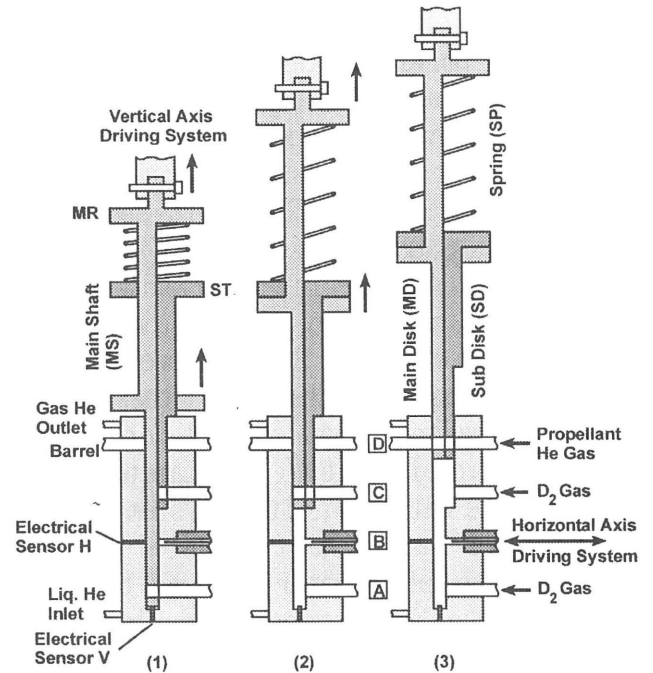


Fig. 1 Schematic of the cryohead part of the device for producing a tracer-encapsulated cryogenic pellet.

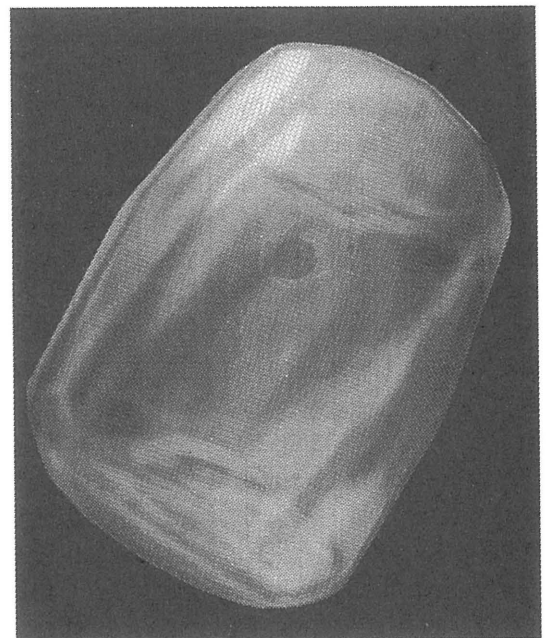


Fig. 2 Example of 3D reconstructed virtual picture of the tracer-encapsulated pellet.