DEPARTMENT OF AEROSPACE ENGINEERING

Faculty Name	:	**Dr.A.Arun Negemiya, AP/ Aero**	Academic Year	:	**2024-2025 (Odd)**
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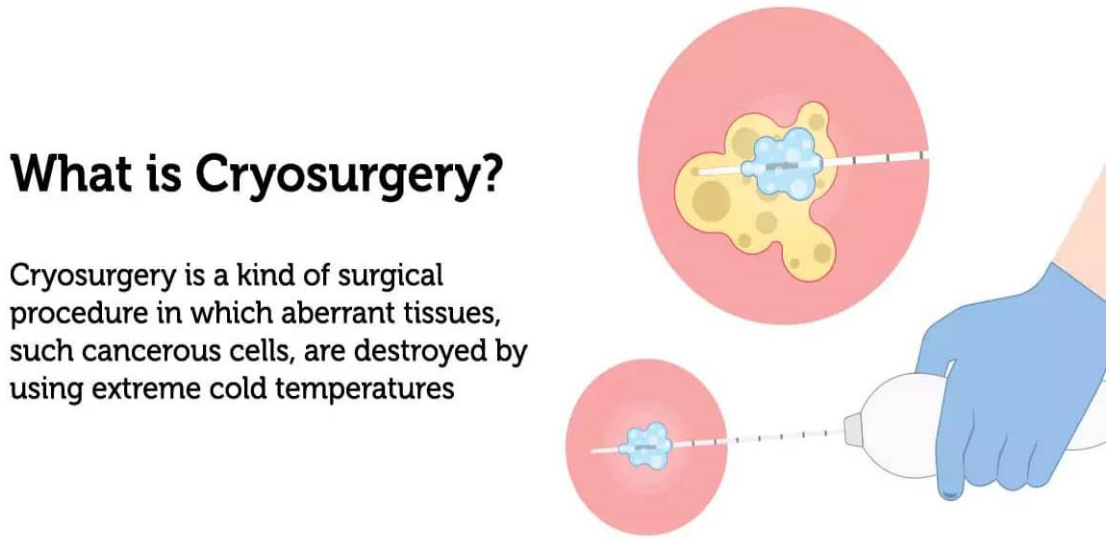
Course	:	**19AST301 - Space Propulsion**			

UNIT IV - CRYOGENIC EQUIPMENT

Applications and uses:

Cryosurgery

Cryosurgery is a minimally invasive surgical technique that involves the use of extreme cold to destroy or remove abnormal tissues, such as tumors or warts. The procedure involves applying a freezing agent, such as liquid nitrogen or argon gas, directly onto the targeted area. This causes the tissue to freeze and ultimately die, allowing the body to naturally eliminate the damaged cells.



The science behind cryosurgery is based on the principle of controlled tissue destruction by rapid freezing and thawing. When the targeted tissue is exposed to extreme cold, the water inside the cells freezes and expands, causing the cell walls to rupture and the cells to die. The body's immune system then works to remove the dead tissue, leaving healthy tissue behind.

Cryosurgery has many advantages over traditional surgical techniques. It is a minimally invasive procedure that can be performed on an outpatient basis, reducing the need for hospitalization and recovery time. It also results in less scarring and pain compared to traditional surgery, and has a lower risk of infection and complications.

Cryosurgery is commonly used in dermatology to treat skin conditions such as warts, actinic keratosis, and skin cancers. It is also used in other medical specialties such as gynecology, urology, and gastroenterology to treat various conditions.

Cryoelectronic Cooling

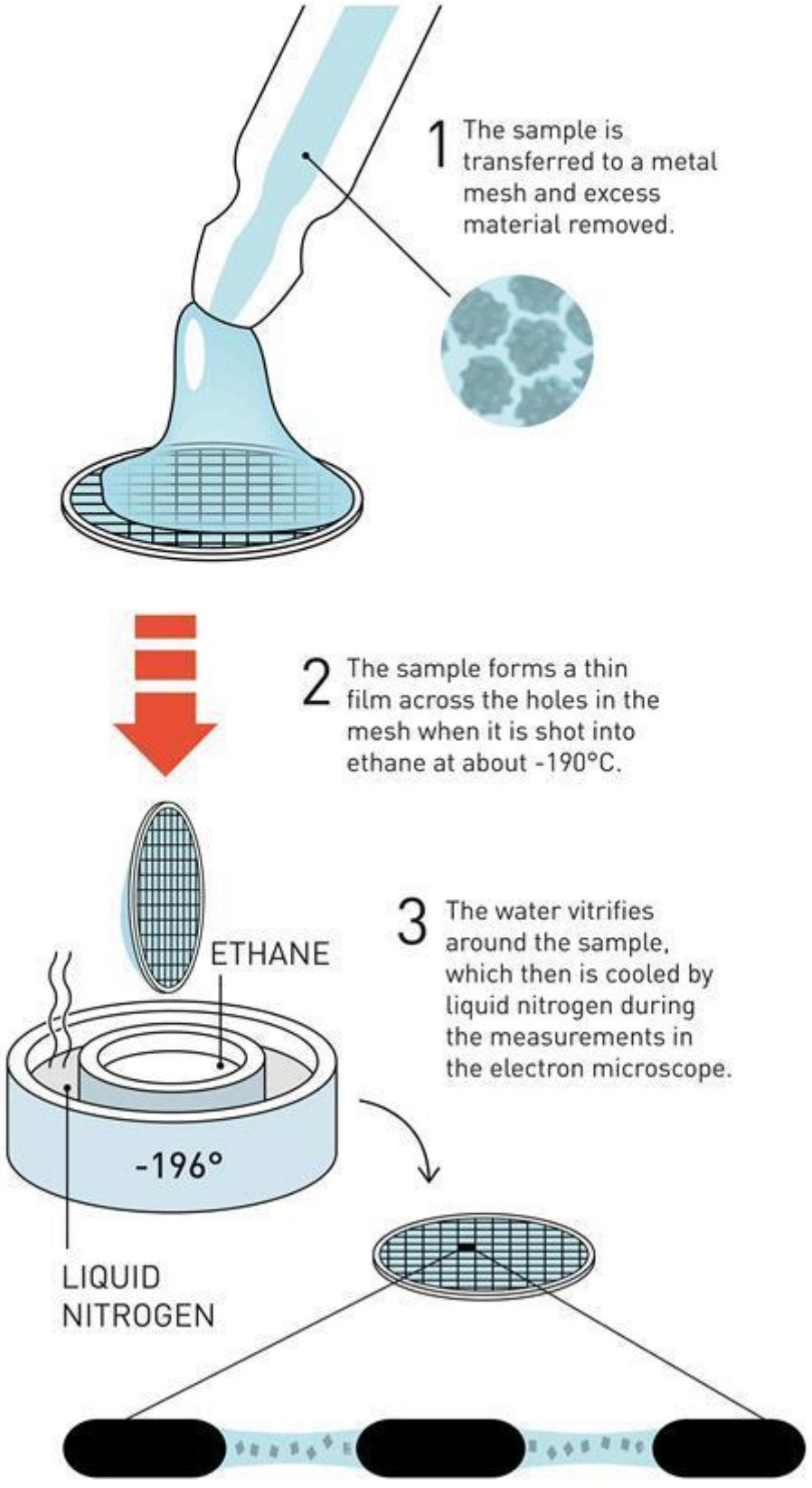
Cryoelectronic cooling is an innovative technology that has revolutionized the field of superconductivity and spacecraft design. It involves the use of extreme cold temperatures to enable electrons in materials to move freely with little resistance. This technology has many advantages over traditional cooling methods, such as liquid cooling, because it is more efficient, reliable, and cost-effective.

In superconductivity research, cryogenic engineering plays a vital role in maintaining the low temperatures required for superconducting materials to operate at their full potential. These materials have the ability to conduct electricity with zero resistance when they are cooled to near absolute zero (-273.15°C). By using cryoelectronic cooling, scientists are able to achieve and maintain these extremely low temperatures, allowing for the creation of more efficient and powerful superconductors.

In addition to superconductivity research, cryoelectronic cooling is also used in spacecraft design. Spacecraft that travel through outer space are exposed to extreme temperatures, which can cause damage to their electronic systems. Cryoelectronic cooling provides a reliable and efficient way to maintain the temperature of electronic systems in spacecraft, ensuring that they operate at optimal performance levels.

One of the major advantages of cryoelectronic cooling is that it is a highly efficient method of cooling, requiring only a small amount of energy to maintain the required low temperatures. This makes it an ideal choice for space applications, where energy conservation is critical. Additionally, cryoelectronic cooling is a reliable and cost-effective method of cooling, with few moving parts and minimal maintenance requirements.

DUBOCHET'S VITRIFICATION METHOD



Cryobiology

Cryobiology is the study of the effects of low temperatures on organisms. There are six major areas of cryobiology:

- The study of cold-adaptation of microorganisms, plants, animals and vertebrates
- Cryopreservation of cell tissues and embryos used in invitro fertilization
- Preservation of organs
- Lyophilization, the freeze-drying of pharmaceuticals
- Cryosurgery
- Supercooling as applied to biological systems

Food Preservation

Cryogenics keeps foods fresh without chemical risk. It is an effective technique for food preservation that is used to maintain the quality and freshness of various food products.

Cryogenic preservation isn't just about cold - it freezes food products quickly so that it maintains its consistency, texture and taste. This makes cryogenic preservation an excellent option for high-value food items such as seafood, meat, and vegetables. This technique is particularly useful for maintaining the texture and quality of delicate food products that are easily damaged by other preservation methods such as heat treatment or dehydration.

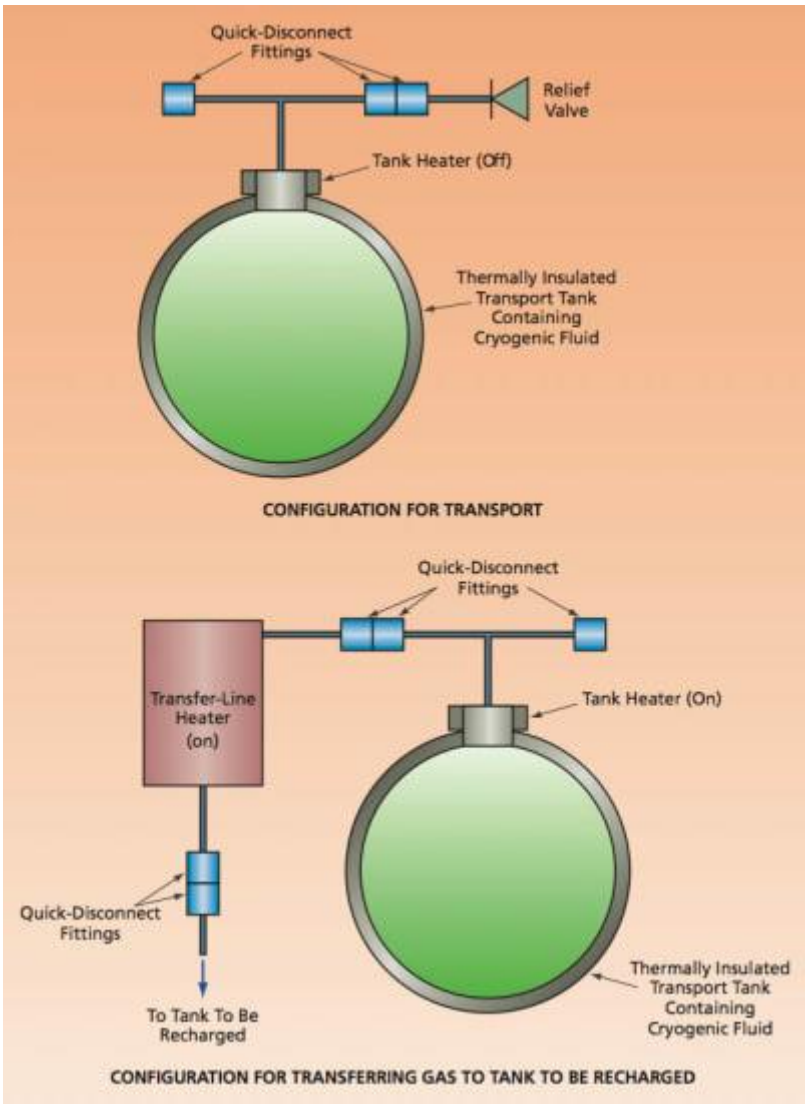
Another benefit of cryogenic preservation is its ability to extend the shelf life of food products. By freezing food products at ultra-low temperatures, the growth of microorganisms that can

cause spoilage and decay is inhibited, reducing the risk of foodborne illness and increasing the overall safety of the product.

To preserve packaged foods such as produce, the food items are typically sprayed with liquid nitrogen to absorb the heat within the produce. The nitrogen quickly evaporates before the food is packaged.

Transportation of Gases

Cryogenics is also used to transport gases that are not typically cryogenic. For example, using cryotechnology, gases can be transformed into liquids to make them easier to transport from one place to another. Take natural gas (LNG) which is a combination of ethane, methane and other gases. When these gases become liquefied, they take up far less space than if they remained gaseous. Therefore, transportation expenses become lower and the process becomes much easier.



Cryotherapy

Cryotherapy is a medical treatment that involves exposing the body to extremely cold temperatures. This can be achieved through various methods, including cryosaunas and cryospas, which allow individuals to stand in a chamber filled with cryogenic fluids for several minutes.

Proponents of cryotherapy claim that it offers numerous benefits to the body, including reducing inflammation, increasing energy, managing pain, and boosting metabolism. While research on cryotherapy is still relatively new, several studies have shown that it can be effective in reducing inflammation and pain in certain conditions, such as rheumatoid arthritis and fibromyalgia.

However, there are also potential risks associated with cryotherapy. Excessive exposure to cold temperatures can lead to hypothermia, which can be life-threatening. Additionally, cryotherapy can cause skin damage, particularly if the skin is wet or has open wounds.

Furthermore, while some individuals may experience immediate relief from pain and inflammation following cryotherapy, the long-term benefits of the treatment are still unclear. Some studies have suggested that cryotherapy may not be effective for all individuals and may even be harmful in some cases.

Cryonics

Cryonics is the process of cryo-preservation of humans or animals in the hope of reviving them at a later time when medical technology is advanced enough to cure the underlying cause of their death. Cryonics involves cooling the body to very low temperatures in a cryonic container filled with liquid nitrogen.

The cryopreservation process is performed immediately after death or sometimes even before if the individual is terminally ill and has chosen to undergo cryonic preservation. The goal of cryonics is to preserve the brain and other vital organs to enable future medical professionals to revive the person with their memories, consciousness, and personality intact.

While cryonics is a controversial topic, proponents argue that it offers hope for individuals who have been diagnosed with terminal illnesses or who may die from other causes. They argue that the advances in medical technology may one day make it possible to revive and cure the underlying cause of death, allowing individuals to continue living. Critics, however, argue that cryonics is a pseudoscience and that the chances of successfully reviving an individual are extremely slim. They also argue that the process of cryopreservation can cause significant damage to the body, and that it is unethical to offer false hope to individuals and their families.

HOW THE PROCESS OF CRYONICS WORKS