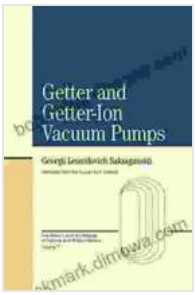
Getter And Getter Ion Vacuum Pumps: Physics And Technology Of Particle And



Getter And Getter-Ion Vacuum Pumps (Physics and Technology of Particle and Photon Beams / , Vol 7)

by H.S.M. Coxeter

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to Getter and Getter-Ion Vacuum Pumps

In the realm of scientific research and industrial applications, achieving and maintaining a high vacuum environment is crucial. Getter and getter-ion vacuum pumps play a pivotal role in creating and sustaining such ultra-low-pressure conditions, making them indispensable tools in various fields.

This comprehensive guide will delve into the fascinating world of getter and getter-ion vacuum pumps, exploring their physics, technology, and the advancements that have propelled particle and ion beam science forward.

The Physics of Getter and Getter-Ion Vacuum Pumps

Getter and getter-ion vacuum pumps operate on the principle of gas adsorption and ionization, respectively. Getter materials, typically metals with high surface reactivity, are used to capture and trap gas molecules from the vacuum chamber. This process effectively reduces the number of gas particles per unit volume, creating a high vacuum.

Getter-ion pumps enhance the pumping efficiency by ionizing the adsorbed gas molecules. This ionization creates positively charged ions, which are then accelerated towards a negatively charged electrode. The collision between the ions and the electrode releases energy, further expelling the gas particles from the vacuum chamber.

Types of Getter and Getter-Ion Vacuum Pumps

Getter and getter-ion vacuum pumps come in various types, each tailored to specific applications and vacuum requirements.

- **Non-Evaporable Getter (NEG) Pumps:** NEGs use non-evaporable getter materials, such as zirconium-vanadium (Zr-V) or titanium-zirconium-vanadium (Ti-Zr-V) alloys. These pumps are characterized by their high pumping speed and long lifespan.
- **Evaporable Getter Pumps:** Evaporable getter pumps employ getter materials that are evaporated onto a substrate, forming a fresh and highly reactive surface for gas adsorption. These pumps offer fast pumping speeds and can handle large gas loads.
- **Ion Pumps:** Ion pumps utilize an electron beam to ionize the gas molecules and accelerate them towards a negatively charged collector, achieving high pumping speeds for light gases such as hydrogen and helium.

Applications of Getter and Getter-Ion Vacuum Pumps

Getter and getter-ion vacuum pumps find widespread applications in numerous scientific and industrial fields, including:

- **Particle Accelerators:** Getter and ion pumps create and maintain the ultra-high vacuum required for particle accelerators, enabling the acceleration and collision of charged particles.
- **Mass Spectrometry:** Vacuum pumps are essential for mass spectrometry, where they remove gas molecules and create a controlled vacuum environment for analyzing samples.
- **Semiconductor Fabrication:** Getter pumps are used in semiconductor fabrication to remove impurities and create the clean and dry environment necessary for chip manufacturing.
- **Vacuum Coating:** Getter pumps ensure a high vacuum in vacuum coating processes, preventing contamination and enhancing the quality of the deposited films.
- **Research and Development:** Getter and getter-ion vacuum pumps support various research and development projects in physics, chemistry, and materials science.

Advancements in Getter and Getter-Ion Vacuum Pump Technology

The field of getter and getter-ion vacuum pumps has witnessed significant advancements in recent years, driven by the demand for higher pumping speeds, lower outgassing rates, and increased reliability.

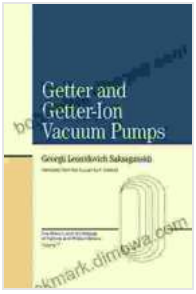
- **Nano-Crystalline Getter Materials:** Nano-crystalline getter materials offer enhanced gas adsorption capacity and faster pumping speeds

compared to conventional getter materials.

- **Active Getter Regeneration:** Active getter regeneration techniques, such as radio frequency (RF) or microwave heating, enable the regeneration of getters without breaking vacuum, extending their lifespan and reducing maintenance costs.
- **Low-Outgassing Materials:** The use of low-outgassing materials in pump construction minimizes the release of gas molecules into the vacuum chamber.
- **Integrated Monitoring Systems:** Getter and getter-ion vacuum pumps now incorporate monitoring systems that provide real-time data on pump performance, allowing for preventive maintenance and optimized operation.

Getter and getter-ion vacuum pumps are indispensable tools in scientific research and industrial applications, enabling the creation and maintenance of ultra-high vacuum environments. Their evolution over the years, driven by advancements in materials science and technology, has pushed the boundaries of particle and ion beam physics.

As the demand for higher vacuum levels and more efficient pumping solutions continues to grow, the field of getter and getter-ion vacuum pumps promises further innovations and advancements, unlocking new possibilities in scientific research and technological applications.



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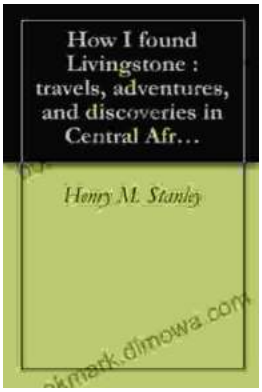

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