

Properties and use of Non Evaporable Getters (NEG) pumps for scientific and industrial vacuum applications

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Non Evaporable Getters (NEGs) are very reactive alloys, generally made of zirconium or titanium, which sorb gases very efficiently in a vacuum system.

Gas molecules are dissociated on the getter surface and permanently trapped in the form of stable oxides, carbides or nitrides. If the getter temperature is sufficiently high (e.g. > 250°C), dissociated atoms diffuse from the surface into the bulk, thus leaving a free surface available for additional pumping. Hydrogen, which has a small atomic radius, can quickly diffuse in the getter bulk even at room temperature, making NEG the ideal solution for H₂ absorption.

NEG materials can be assembled into high efficiency pumps, whose structures and properties are optimized to provide extremely high pumping speed for all active gases in UHV and XHV regime.

Compared to other vacuum pumps NEG pumps have several interesting features. Pumping speed does not decline with low pressure, like sputter ion pumps. NEGs are more effective than turbo or cryogenics pumps for H₂, the main residual gas in UHV-XHV. They require little or no power and are light weight and compact. Being oil-free and vibration-free NEGs are ideally suited for clean systems where contamination and mechanical disturbance are an issue. Also, getter pumps do not generate magnetic/electric fields. For these reasons, NEG pumps have found widespread use in basic and applied research, such as particle accelerators, storage rings, synchrotrons and physics projects where UHV or XHV conditions are mandatory. Pressure in the range of 10⁻¹¹ mbar are currently achieved in many machines using NEG pumps and values lower than 10⁻¹² mbar have been measured in various experiments. Recent machines using NEG pumps includes the Swiss FEL, TPS and ESRF light sources, super KEK B and ELENA ring at CERN.

NEG pumps are also currently applied in many industrial and research applications encompassing scanning electron/transmission microscopy, electron beam lithography, semiconductor processing, thin film deposition, material preparation, surface science and mass spectrometers equipment or atom trapping systems.

They can be mounted inside a process chamber providing conductance-free pumping ability which helps to increase productivity and reduce pump down time. Process yields and material quality are also increased, since impurities are removed during the processing. Since they can operate without electrical power, NEG pumps are the ideal choice for portable analytical instruments or for remote applications.