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Getter Materials

By Dan Herring

Experience has shown us that sensitive materials in the p contaminates can destroy the integrity and shorten the life exp what can be done to further protect the work in a vacuum e reducing the chamber pressure to as low as is economically on getter materials.

What is a Getter?

A getter is simply a reactive material that is deliberately placed ir efficiency of that vacuum by scavenging unwanted contaminates. E they combine with it chemically or by adsorption so as to be re eliminates even minute amounts of unwanted gases from the evacu

Getter materials fall into three broad categories: bulk getters, coa from simple foils, wraps and stamped forms to machined turning applied to the surface in the form of coatings or placed in the gas st furnaces whether graphite or metallic (e.g. molybdenum and/or especially important when processing reactive metals such as titar tubes, cathode ray tubes and the like. The sophistication of the gett

Getter Properties

The action of a getter material depends on:

- Adsorption (i.e. accumulation of gas molecules at the surface)
- Absorption (i.e. diffusion of gas molecules in the solid);
- Chemical binding (i.e. reaction with the surface atoms).

A getter material is designed to react with the gas species present, creating a chemical reaction. Typical gases present in vacuum sys are carbon monoxide (CO), carbon dioxide (CO_2), nitrogen (hydrogen (H_2), and water vapor (H_2O). Most metal surfaces ha protective oxide on them, which under vacuum and at high temper must dissolve and diffuse into the getter material before it ca effective. Thus a getter material must also have the ability to a diffusion of contaminating gases once they have been absorbed.

Getters bind gases on their surfaces. Thus, the greater the surfa

Getter Material	Gas species	Getter Capacity (Pa-l/mg)
Aluminum	Oxygen (O_2)	1.00
Barium	Carbon Dioxide (CO_2)	0.69
	Hydrogen (H_2)	11.50
	Nitrogen (N_2)	1.26
	Oxygen (O_2)	2.00
Magnesium	Oxygen (O_2)	2.70
Rare Earth Elements (cerium, lanthanum)	Carbon Dioxide (CO_2)	0.29
	Hydrogen (H_2)	6.13
	Nitrogen (N_2)	0.43
	Oxygen (O_2)	2.80
Titanium	Hydrogen	27.00
	Nitrogen	0.85
	Oxygen	4.40

Table 1 [1] Getter Capacity of Common Materials

10^{18} particles (i.e. 6.7 x 10^{18} hydrogen molecules or 1.34 x 10^{19} hy
10^{19} titanium atoms so that each titanium atom in the getter corresp

The chemical reactions (in simplified form) are as follow (here GM r

(1) $2GM + O_2 \rightarrow 2GMO$
(2) $2GM + N_2 \rightarrow 2GMN$
(3) $2GM + CO \rightarrow GMC + GMO$
(4) $2GM + CO_2 \rightarrow CO + 2GMO \rightarrow GMC + GMO$
(5) $GM + H_2O \rightarrow H + GMO \rightarrow GMO + H$ (bulk)
(6) $GM + H_2 \rightarrow GMH + H$ (bulk)
(7) $GM + C_xH_y \rightarrow GMC + H$ (bulk)
(8) GM + Inert Gas (He, Ne, Ar, Kr, Xe) → No reaction

Getter capacity is affected by temperature since diffusion rates of th material increase with temperature. This helps keep the getter surfa gases that bind only to the surface due to chemical reactions. Adso saturation).

Titanium can be used as an effective getter material when running t surfaces clean (i.e. to avoid oxidation and discoloration) during ann 1400°F) range, titanium scrap (often in the form of clean, dry mach

Non-Evaporative Getters

Non-evaporable getters have become an integral part of many ultra
surface properties which are conducive to achieving extremely high
or lower). Binary, ternary and multicomponent alloys from Group IV
are most often used. These generally consist of a film of a special a
alloy materials must form a passivation layer at room temperature v
have names of the form St (Stabil) followed by a number:

- St 707 - a 70% zirconium, 24.6% vanadium balance iron alloy
- St 787 - a 80.8% zirconium, 14.2% cobalt balance mischmeta
- St 101 - a 84% zirconium and 16% aluminum

In tubes used in electronics, the getter material coats plates within t
getters are used within more general vacuum systems, such as in s
separate pieces of equipment in the vacuum chamber, and turned c

Final Thoughts

For heat treaters, getters are often considered a last resort to help l
important role in successful vacuum processing of many highly sop
do a better job of understanding their role; how and where they can

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