AST PRODUCTS, INC.
9 Linnell Circle
Billerica, MA 01821-3902
978.667.4500
www.astp.com FAX 978.667.9778

Plasma Surface Treatment of Catheters to Promote Adhesion

by

Maria A. Hozbor

INTRODUCTION

The use of catheters in the medical industry has been steadily growing over the past several years. The applications which utilize catheters are varied, including cardiac and vascular, respiratory, wound-drainage, urethral, and renal. The invasive method in which catheters are used calls for strict production standards and guaranteed reliability.

Because of their varied applications, catheters are comprised of a variety of components and materials. Combining widely differing materials, while maintaining the high reliability standards expected, often poses a challenge. Plasma surface treatment provides a method by which materials with dramatically different surface characteristics may be bonded together.

PLASMA TECHNOLOGY

Cold gas plasma surface treatment is a proven technology used to improve the adhesion characteristics of polymers. The treatment takes place in a vacuum chamber wherein materials are exposed to a plasma. A plasma is created when a process gas is ionized using radio frequency energy. The active species generated interact with the outer molecular layers of the material to be treated. Free radicals are produced and specific chemical functional groups are incorporated into the surface. With the proper choice of gas chemistry, the treated surface can be specifically designed to interact with a desired adhesive.

Since the plasma treatment occurs in a vacuum, the process parameters can be precisely controlled and consistently reproduced. These process variables include gas chemistry, pressure, power, and process time. This reproducible treatment allows for a higher level of confidence in subsequent processing steps, such as component adhesion.

ENHANCED ADHESION

Numerous materials have been treated at Himont Plasma Science in order to increase bondability. For example, adhesion between polyethylene and polyethylene terephthalate films has been dramatically increased after plasma treatment. The increased adhesion was observed across a wide range of adhesives. The bond strengths observed for the plasma treated materials were superior to those processed using conventional chemical or physical methods. Furthermore, the possible contamination of the material as a result of residue from a chemical adhesion promoter, or particulates from a physical abrasion technique, is not an issue when using a cold gas plasma. The plasma treated films gave reproducible bond strength values. The following table presents examples of common materials and associated bond strengths with and without plasma treatment:

Polymer	Treatment	Bond Strength, psi Average	Low	High
HDPE	none	320	260	370
	He plasma	3130	3050	3230
	O_2 plasma	2520	2460	2610
Nylon 6	none	800	640	1020
	He plasma	2760	2390	3460
	O_2 plasma	3490	3140	3780
Polypropylene	none	370	—	—
	He plasma	2600	—	—
	O_2 plasma	3080	—	—

The use of a cold gas plasma to modify polymer surfaces for improved adhesion is a clean, reproducible method which ensures consistent quality. Plasma treatment of catheters to promote bonding offers an alternative to preparatory chemical or physical methods which may introduce variability and contamination into processing.