

Table - Advantages and Limitations of Surface Oxidation Methods for Polymer Surfaces

Process	Description	Substrates	Advantages	Limitations
Corona treatment	A thin polymer sheet is rolled through an array of high-voltage electrodes, using the plasma created to functionalise the surface.	Polymers and natural fibres	The limited penetration depth of such treatment provides vastly improved adhesion while preserving bulk mechanical properties.	The hazardous nature of remnant ozone after corona treatment stipulates careful filtration and ventilation during processing, restricting its implementation to applications with strict catalytic filtered systems. This limitation prevents widespread use within open-line
		In-line corona treatments have been implemented into full-scale production lines such as those in the newspaper industry. These in-line solutions are developed to counteract the decrease in wetting characteristics caused by excessive solvent use.	Improved dye adhesion before printing text and images on plastic packaging materials.	Several factors influence the efficiency of the flame treatment
			The development of careful transportation techniques allows treatment at an optimized location.	
Plasma processing	The process begins with production of plasma via ionization either by deposition on monomer mixtures or gaseous carrier ions. The power required to produce the necessary plasma flux can be derived from the active volume mass/energy balance.	Metals, textiles and plastics.	Plasma processing provides interfacial energies and injected monomer fragments larger than comparable	Limited fluxes prevent high process rates.
			Small scale in-line treatment and industrial sized vacuum chamber treatments available	
		Ability to treat temperature sensitive materials	Improved bonding of paint and printed inks to polymer	Plasmas are thermodynamically unfavorable and therefore plasma-processed surfaces lack uniformity, these obstacles with plasma processing may preclude it from being a competitive surface modification method.
			Specific surface functionality without affecting bulk	
	Dissipation is generally initiated via direct current (DC), radio frequency (RF), or microwave power.	Treat conductors, semi-conductors and insulators alike	Hydrophobic, oleophobic and hydrophilic properties are	Gas ionization efficiency can decrease the power efficiency more than tenfold depending on the carrier plasma and substrate.
			Ability to treat complex 3D objects and micro-channels	
			Environmentally friendly, no waste chemicals	
Flamed plasma processing	Controlled, rapid, cost-effective method of increasing surface energy and wettability of polyolefins and metallic components. This high-temperature plasma treatment uses ionized gaseous oxygen via jet flames across a surface to add polar functional groups while melting the surface molecules, locking them into place upon cooling.	Plastics - eg polyethylene, polypropylene	Can be almost infinitely 'tuned' to deliver surface specific properties	Flame spraying requires line of sight to the surface being coated, similar to all other thermal spraying processes.
			Very low unit cost per treatment	
			Thermoplastic polyethylene and polypropylene treated with brief oxygen plasma exposure have seen contact angles as low as 22°, and the resulting surface modification can last years with proper packaging.	Difficult or impossible to coat inner surfaces of small diameter bores and other restricted access surfaces.
			Flame plasma treatment has become increasingly popular with intravascular devices such as balloon catheters due to the precision and cost-effectiveness demanded in the medical industry.	