SDBD plasma

TNO's cold atmospheric-pressure SDBD (Surface Dielectric Barrier Discharge) plasma can be tailor-made for cleaning, activation, coating deposition and disinfection of plastics, glass, ceramics and metals. Flat-bed, jet and handheld versions of SDBD plasma generators provide required flexibility for the treatment of these materials in any shape and at any circumstances.

PLASMA

Plasma, sometimes called the fourth state of matter, can be generated by means of an electrical gas discharge. The electrons gain energy from the electric or electromagnetic field and lose their energy in various ways such as ionizing collisions, exciting atoms to light emitting states and dissociating molecules into chemical reactive radicals and compounds.

PLASMA SURFACE MODIFICATION

Cold (20-60°C) atmospheric-pressure plasma processing is increasingly used in surface and interface engineering of polymers, papers, metals, glass and ceramics in the form of (nano, micro) particles, filaments, yarns, woven and nonwovens, sheets, plates and foils.

According to its various functions, it can be classified into plasma etching/cleaning, plasma activation, plasma-assisted grafting, and plasma polymerization. Plasma etching/cleaning involves removal of material from the treated surface. Plasma activation uses mechanisms such as hydrogen abstraction and introduction of new functional groups like hydroxyl, carbonyl, amino and imino groups. Plasma-assisted grafting consists of plasma activation followed by exposure of the treated surface to a precursor undergoing a conventional polymerization. In plasma polymerization, a precursor is introduced directly into a plasma, and the polymerization occurs in the plasma itself.

SDBD PLASMA FOR SURFACE MODIFICATION

Compared to other types of plasma processing, TNO's Surface Dielectric Barrier Discharge (SDBD) plasma processing is more homogeneous and requires shorter treatment time and less energy. Selected examples are giving an indication of its possible utilization.
ACTIVATION
The SDBD plasma has been successfully used for activation of various materials, ranging from PE and PP through PET to ETFE, PVDF, PTFE, but also paper, glass, some metals and TCO’s leading to an increase of their surface energy.

POST-ACTIVATION PROCESSING
Such activation has been used to:
• prepare surfaces for subsequent processing like self-assembly of polyelectrolytes, dyes and nanoparticles
• incorporate the same type of functional groups on variety of materials to allow bonding without redesigning the coating’s molecular structure
• improve surface coverage and spreading of coatings
• reduce the amount of applied coating
• enhance a coating functionality
• enhance adhesion of various coatings (glue, varnish, ink) to a large variety of materials (see top picture)

PLASMA-ASSISTED GRAFTING
As an example, a SDBD plasma pre-treatment facilitated bonding of the TNO-synthesized quaternary-ammonium chemicals to chosen substrates and resulted in enhanced performance of these non-leaching biocidal coatings against micro-organisms like E. Coli, Staphylococcus aureus, Streptococcus pyogenes, E. faecalis, A. baumannii, K. pneumonae, Proteus mirabilis and Candida albicans.

PLASMA POLYMERIZATION
Highly hydrophobic polymer layers have been deposited, for example, on cotton and aramid wovens, glass beads and glass fibre non-wovens by means of the SDBD plasma polymerization of HMDSO.
This technique has also been successfully used to deposit nanocomposites containing agglomerated or well dispersed nanoparticles (e.g. TiO2, ZnO, MgO) on a variety of materials without limitation on the type or concentration of nanomaterial.

EVALUATION
At TNO Eindhoven both the experience and the facilities are available to determine the feasibility of your specific application. This will provide insight in effectiveness, treatment times and costs which allows an objective comparison with possible alternatives.