

Perfect Metal to PC Bonding?

Gira's Impermeable Oxygenator Fitting Makes the Grade

By Graham Porcas, director, Plasmatreat UK

For medical device manufacturers, plasma treatment offers significant benefits for the surface treatment of components to facilitate and improve adhesion and bonding potential. The technology is ideal for cleanroom environments as it can be integrated into fully automated high speed production lines. It is also completely clean (it's essentially a series of jets of ionised air) and the treated surfaces do not produce any dust. In the following case study we present how plasma treatment has enabled a German company to produce metal and plastic oxygenator fittings as a single part.

Plasma treatment is based on the principle that when energy is added to a gas, that gas becomes ionised — that is to say the electrons gain more kinetic energy and leave their atomic shells. This builds on the simple principle of state change in physics. When you add energy to a substance, the states of matter change. By adding energy to a solid it turns into a liquid and then into a gas.

Adding energy to a gas creates a plasma — also known as the “fourth state of matter” — which consists of free electrons, ions and molecular fragments. When these are applied to a material, they create a change on its surface at a molecular level in order to improve its propensity for bonding and adhesion. In addition, any contaminant on the surface

can be removed, providing a valuable cleaning effect.

At normal atmospheric pressure the ionised gas is relatively useless for industrial applications because it is highly instable. In order to utilise the benefits of plasma the gas needs to be kept at a lower pressure than that of the surrounding atmosphere.


When Plasmatreat's Openair plasma technology was developed in 1995 it opened up new opportunities. By developing and using plasma jets, or nozzles, it became possible for the first time to integrate plasma into industrial production processes at atmospheric pressure. The nozzles shoot a sharp burst of free ions onto the surface of a material, allowing “activation” of the surface as well as removal of any microscopic contaminants. The technology can be integrated inline, meaning it can be used for large scale pretreatment of material surfaces at normal atmospheric pressure.

Perfect Metal to Polycarbonate Bonding


Germany-based manufacturer of plastic electrical goods, Gira, uses Openair plasma technology in a class 10,000 injection moulding cleanroom to produce complex fittings for oxygenators. An oxygenator is a medical device that is capable of exchanging oxygen and carbon dioxide in the blood of a human patient during surgical procedures.

The fittings are a critical component of the oxygenator. Inside each fitting is a metal insert (pictured) which, during an operation, measures the temperature of the blood. If the temperature changes it triggers the heat exchanger to adapt and maintain a constant temperature.

The metal insert is placed in the mould and then overmoulded with



<< Plasma treatment enables critical metal and plastic parts to be injection moulded as a single component. Source Gira. >>

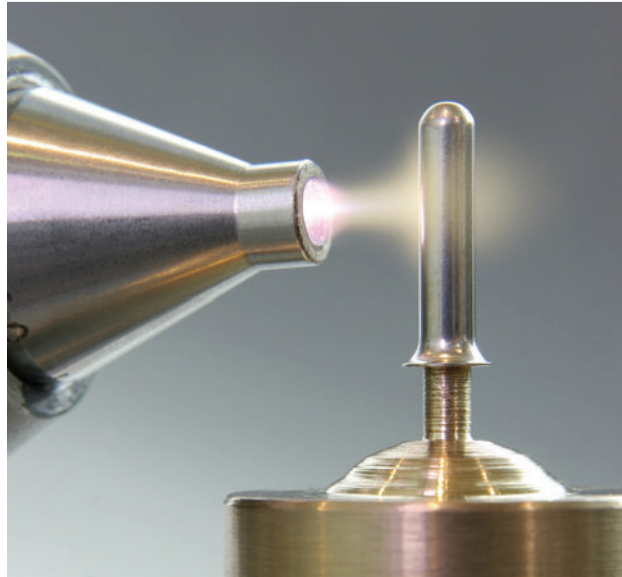


<< The finished components are checked in the cleanroom under extremely stringent reliability requirements. If the fittings fail, someone's life will be in danger. Source Gira. >>

polycarbonate. The bonding between the metal and the polycarbonate must be absolutely impermeable to ensure that the fitting functions reliably. And this is where plasma treatment comes in. Apparently, extensive tests have shown that pretreatment with plasma is the only process which can fulfill the requirements of the part. Also, due to the close contact with the blood, the use of adhesion



<< Plasma treatment activates and cleans the metal inserts to ensure perfect impermeability before they are placed into the mould. Source Gira. >>



modified compounds or an additional bonding agent layer is not permitted by guidelines regulating the device.

To produce the fitting, prior to moulding individual metal parts are picked up by a robot from a spiral conveyor and deposited in the plasma treatment station. The atmospheric plasma beam pulsates at approximately two second intervals to activate and clean the rotating work pieces over their entire surface area before the inserts are placed in the mould by the robot ready for moulding. As the inserts are placed in the mould, finished components are removed.

The plasma operates directly on the surface of the metal and ensures that the melt polymer wets the metal surface for perfect impermeable bonding. Any organic impurities which might inhibit this process are oxidised away. As a result of this "activation", the metal's surface energy increases to more than 72 mJ/m². Plasmatreat's integrated monitoring system ensures that this step proceeds correctly and without errors. 