Method of plasma treatment of an internal and/or external surface of a hollow electrically non-conductive body and a device for carrying out this method

Development status

Phase 3

Technology validation and implementing it in real environment. Testing the technology outside of the laboratory and its adjustment to external conditions.

IP protection status

Patent of the Czech Republic and Singapore. European patent is validated in Germany, France, United Kingdom of Great Britain and Northern Ireland, Ireland, Italy and Switzerland. Patent pending in the USA.

Partnering strategy

licensing

Institution

Challenge

One of the most significant areas of plasma applications are surface activations of various materials, where active plasma species interact with the surface removing the contaminants and/or introducing new functional groups. In this way, the surface properties as wetting, printability, antimicrobial activity etc., may be significantly influenced. However, till now, there is no plasma-treatment solution which allow process the long hollow bodies at atmospheric pressure and in-line production. For these modifications, so-called wet methods are currently used, where the desired properties are achieved using liquid solvents and aggressive solutions of acids and bases. The present method offers surface treatment by using electric plasma generated at atmospheric pressure from the liquid surface (the liquid electrode does not corrode and erode).

Description

The invention is a method for plasma treatment of the internal and/or external surface of a hollow electrically non-conductive bodies (e.g. hoses, tubes, bottles, containers, test tubes and cuvettes, hollow fibers and similar hollow instruments and aids used in medicine such as blood bags and similar containers for medical application) in order to obtain the desired surface properties for their end use (e.g. hydrophilicity or hydrophobicity, biocompatibility, antimicrobial properties, and the like). The essence of the invention consists in that the internal surface of a hollow electrically non-conductive body and/or on the external surface of a hollow electrically non-conductive body is treated with a layer of electrical plasma of a surface dielectric barrier discharge generated in a volume of gas using alternating or pulse voltage with an amplitude higher than 100 V from a pair of liquid

MUNI Technology Transfer Office TTO

Masaryk University

internal electrodes consisting of an internal electrically conductive liquid situated inside a hollow electrically non-conductive body and an external electrically conductive liquid situated outside a hollow electrically conductive body. The advantage of using an electrically conductive liquid consists in that no corrosion and erosion of such electrodes occurs. The electrical plasma is generated above the surface of the electrically conductive fluid, wherein in the volume of the gas there forms a layer of electrical plasma forming a ring copying the shape of the surface of the hollow electrically non-conductive body. The electrical resistance between the liquid electrodes is greater than 10 kΩ. The electrical plasma is produced above the surface of the liquid electrode and on the surface of the hollow electrically non-conductive body whose internal or external circumference it copies. The ring of the electrical plasma forms in the volume of gas volume above the liquid electrode. If the vessel or hollow body is completely filled with the liquid electrode, the ring of electrical plasma cannot form above the surface of this liquid electrode. Conversely, if the level of internal and external electrically conductive liquid forming the liquid electrode is approximately at the same height and does not fill the entire volume of the reagent vessel and the hollow body, the ring of electrical plasma forms along the internal and external circumference of the hollow electrically non-conductive body.

Commercial opportunity

The device for plasma treatment of the external and internal surfaces of an electrically non-conductive hollow body can be used mainly in production processes where it is often necessary to modify the properties of surfaces of products (eg hoses, tubes, bottles, containers, cuvettes, fibers and capillaries, catheters and similar hollow instruments and aids used in medicine such as blood bags and similar containers for medical use) in order to obtain the desired surface properties for their end use (e.g., hydrophilicity or hydrophobicity, biocompatibility, antimicrobial properties, electrical conductivity, surface permeability for gases and liquids, sorption properties, adhesion). For these mentioned surface treatments, so-called "wet methods" are typically currently used. Through the use of liquid solvents and aggressive acidic and alkaline solutions, it is possible to achieve, for example, the cleaning and etching of surfaces, biological decontamination, surface activation, the creation of chemical groups, covering a surface with thin layers of other materials, and surface immobilization of nanoparticles. The present method provides such treatment without the disadvantages associated with the use of heavy chemistry (e.g., hazardous handling, toxic waste), namely by using

electrical plasma generated at atmospheric pressure from a surface of a liquid. The advantage of using an electrically conductive liquid is that it does not corrode and erode the electrodes. Plasma surface treatment is fast and homogeneous.