

Radiofrequency low-temperature plasma source for biomedical use

The radiofrequency plasma source is a tool developed at Consorzio RFX (Italy) whose main research field is magnetically confined fusion plasmas. The plasma source is a handheld device producing a helium low-temperature atmospheric pressure plasma that creates active chemical species enabling biological and therapeutic effect with no direct contact.

RFX holds a European patent on the device and seeks companies willing to get a license to develop a commercial product.

■ Description of the technology

The RF plasma source for biomedical applications is a tool developed at Consorzio RFX in Padova, Italy, a research institute set up by the major Italian research institutions (CNR, ENEA, INFN), University of Padova and Acciaierie Venete S.p.A. Its primary mission is to perform research in the field of magnetically confined fusion plasmas.

The RF plasma source is a handheld device which produces a helium low-temperature atmospheric pressure plasma, which in turn creates from surrounding air oxygen and nitrogen active chemical species, which can give rise to biological and therapeutic effect within the frame of the so-called plasma medicine. The source is mainly constituted by two parallel planar grids, 1 mm apart. An inner one with a diameter of 10 mm, made of a brass wires is at the end of a tube made of an insulating plastic material. The outer grid, with a diameter of 12 mm, is also made of brass wires. The latter is electrically connected to one end of a grounded copper tube (12 mm outer diameter). A Helium gas flow, with a typical value of 2 L/min runs through the tube connected to the inner grid. A radiofrequency (at about 5 MHz) voltage difference, produced by an ad-hoc power supply, is applied to the two grids, with peak to peak values typically of the order of 1 kV, so that a diffuse glow discharge is established in the space between them. The power coupled to the plasma is very low, of the order of 0.5 W, so that no appreciable heating of the gas takes place.

Effects which have been demonstrated with in-vitro studies include disinfections from bacteria and fungi (with particular emphasis to the application of disinfection of the cornea), acceleration of wound healing, and selective killing of cancer cells. Other potential applications are related to dermatological treatments. In the context of corneal infections, the device could be used to effectively treat cases which have proven not to respond to traditional therapies. For wound healing applications, the treatment has the strong advantage of being painless. Finally, for cancer treatment it could be used in the operating theatre to complement surgical tumor removal, making sure that residual cancer cells are induced to commit apoptosis. Furthermore, it could be tested to induce tumor reduction in cases where surgical removal would be problematic.



Prototypes of Radiofrequency low-temperature plasma source for biomedical and plasma medicine applications

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■ Innovation and advantages of the offer

The device is different from other tools developed in the framework of plasma medicine in giving rise to an indirect treatment, with no direct contact of the plasma with the substrate, and no electric current flowing to it. Such gentle treatment makes it suitable to the application to very delicate surfaces, such as the cornea (eye surface). The plasma source has been developed by a team of plasma physicists, with expertise on plasma production at atmospheric pressure and radiofrequency power. The core team has developed a network of collaborations concerning chemical, biological and medical effects. The tool is very easy to use, and can be made easier by appropriate engineering, so that a medical doctor could in principle have just a on/off switch to operate.

■ Non-fusion Applications

In fusion sector the technology is applied in plasma physics and radiofrequency plasma production. Beyond the fusion sector, this technology is applied in plasma medicine for biological and therapeutic effects.

■ EUROfusion Heritage

The plasma medicine activity stems from the excellent expertise achieved by physicist at Consorzio RFX on the topic of plasma physics and radiofrequency plasma production. This expertise is the result of the participation into EUROfusion projects. Consorzio RFX has strong expertise related to physics and engineering issues associated to magnetically confined fusion devices and neutral beams for plasma heating. In particular, theoretical and experimental plasma physics and RF power expertise have been crucial for the development of this plasma source.

