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Biological Application of Plasma: Sterilization, Surface Treatment, and Tissue Engineering

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The presentation reviews modern achievements in using non-thermal plasma for different applications in biology and medicine. Specific features of non-equilibrium atmospheric pressure discharges attractive for biological and medical applications are to be discussed. Primary attention will be focused on such discharges as: dielectric-barrier discharge (DBD) in homogeneous and streamer modes; RF atmospheric pressure glow discharges (RF APG); corona and pulsed corona discharges; gliding arc discharges. Especially novel discharges in liquids efficient for bio-medical applications are to be discussed. Specific non-thermal plasma applications in biology and medicine will be subdivided into three major groups: different kind of sterilization processes; surface treatment and tissue engineering processes; direct cold plasma applications in medicine. Sterilization processes are to be considered separately for treatment of different surfaces, treatment of air, and treatment of water (and other liquids). Specifics related to bacteria, viruses, spores will be addressed. Disinfection is to be compared with low-temperature burning out and complete disintegration. Major sterilization mechanism related to atoms and radicals (OH et al.), ozone, UV, charged particles, excited molecules (singlet oxygen et al.), micro-shocks are to be discussed. Kinetic modeling of plasma sterilization processes will be demonstrated. Surface treatment and tissue engineering applications will be discussed using as an example DBD bio-printer experiments. Direct plasma-medical applications are to be considered using as examples: non-thermal plasma cauterization and blood coagulation; non-thermal plasma treatment of wounds; and non-thermal plasma treatment of skin diseases. Mechanisms of the non-thermal plasma effects in medicine will be discussed; detailed kinetic modeling of the plasma-medical processes is to be compared with experiments.