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COLLECTIVE PHENOMENA IN VOLUME AND SURFACE BARRIER DISCHARGES

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Abstract. Barrier discharges are increasingly used as a cost-effective means to produce non-equilibrium plasmas at atmospheric pressure. This way, copious amounts of electrons, ions, free radicals and excited species can be generated without appreciable gas heating. In most applications the barrier is made of dielectric material. In laboratory experiments also the use of resistive, ferroelectric and semiconducting materials has been investigated, also porous ceramic layers and dielectric barriers with controlled surface conductivity. Major applications utilizing mainly dielectric barriers include ozone generation, surface cleaning and modification, polymer and textile treatment, sterilization, pollution control, CO_2 lasers, excimer lamps, plasma display panels (flat TV screens). More recent research efforts are also devoted to biomedical applications and to plasma actuators for flow control. Sinusoidal feeding voltages at various frequencies as well as pulsed excitation schemes are used. Volume as well as surface barrier discharges can exist in the form of filamentary, regularly patterned or laterally homogeneous discharges. Reviews of the subject and the older literature on barrier discharges were published by Kogelschatz (2002, 2003), by Wagner et al. (2003) and by Fridman et al. (2005). A detailed discussion of various properties of barrier discharges can also be found in the recent book "Non-Equilibrium Air Plasmas at Atmospheric Pressure" by Becker et al. (2005). The physical effects leading to collective phenomena in volume and surface barrier discharges will be discussed in detail. Special attention will be given to self-organization of current filaments. Main similarities and differences of the two types of barrier discharges will be elaborated.

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