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Physics and dynamics of filamentary patterns in dielectric barrier discharges J.P. BOEUF, B. BERNECKER, T. CALLEGARI, LAPLACE, CNRS and Universite Paul Sabatier, Toulouse, France — Dielectric Barrier Discharges (DBDs) can exhibit filamentary structures that are characteristic of a particular class of 2-component reaction-diffusion systems called activator-inhibitor where one component stimulates the production of both components while the other one inhibits their growth. Numerical models predict the formation of self-organized filamentary structures in DBDs and suggest that the ion density in the sheath of a filament plays the role of the activator while the surface charges play the role of the inhibitor. We present studies of dynamic phenomena wherein the filaments do not form at the same space location at each half-cycle but are shifted by half a spatial period, leading to a new stable structure (quincunx). This is due to the existence of residual charges in the discharge volume between filaments at the end of a discharge pulse. We show that the combined effect of remaining surface charges and volume charges may be responsible for many dynamic phenomena, i.e. motion, repulsion, annihilation, and generation of filaments. Moving, localized solutions which remain stable cannot be obtained in the framework of 2-component activator-inhibitor models. However such solutions can be obtained from a 3-component activator-inhibitor model including the volume charge density remaining from the previous discharges, as a third component of the system.

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