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Development of an enhanced MHD micromixer based on axial flow modulation

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A B S T R A C T

A magneto-hydrodynamic (MHD) stirrer was analytically modeled, designed and experimentally tested. A novel modulation technique is presented which allows enhancing the mixing quality in a short amount of time. The stirrer was realized with two PCB layers and a glass cover; the channel presents electrodes posed on the bottom wall and on the sidewalls. All the electrodes are AC fed in order to avoid electrolysis and bubble formation during the stirring process. A fully programmable circuit allows creating vortices inside the mixing channel and to move the fluids with an oscillating motion from inlet to outlet; the electrodes on the bottom wall provide contra-rotating vortices and are fed with AC zero mean value square waves in-phase and in opposition of phase with respect to a magnetic field generated by an electromagnet. The sidewalls are fed by a modulated signal whose carrier is in phase with the magnetic field, while the modulant is a low frequency square wave with programmable frequency, amplitude, DC offset and duty-cycle; as an effect it is possible to make oscillate the fluid from inlet to outlet and enhance the stirring process by interaction of this axial oscillation with the contra-rotating vortices. Experimental efficiency of 90% can be reached in an amount of time of 24 s.