Energy conversion for plasma control of the lift force of an aircraft

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In the first part of the presented work, it was found that with a decrease in pressure and an increase in the length of the exposed electrodes, the efficiency of the "power source—actuator—DBD" system and its capacity significantly increase. This is accompanied by a decrease in the quality factor. The additional energy is spent primarily for producing and maintaining the synthetic jet.
In the second part of the work, the lift force arising from the interaction of a synthetic jet with subsonic airflow at atmospheric pressure was measured. We used symmetric and double symmetric actuators, which were installed both on the lower surface of the profile and on the upper one. Pulsation of vortices in the region of interaction of a synthetic jet with an airflow at a frequency of 1-2 Hz was found.
The synthetic jet, produced by the DBD, interacts with subsonic airflow and forms a long separation bubble. If the actuator is installed near the trailing edge of a symmetrical profile, then this bubble closes outside the wing, forming a "virtual" asymmetrical profile. An in-stream wing mounted actuator adds kinetic and thermal energy to the airflow. If the separated bubbles arising in this case are closed on the airfoil surface, we can speak of the effect of hypercirculation, which, in contrast to the classical blowing of jets onto the flaps, already has a minimum thrust for a continuous flow around. Consequently, any small effect of adding momentum to the flow will be more effective. For the full realization of this effect, the thrust of the synthetic jet may not reach large values, since an essential factor is the amount of energy transferred to the flow in relation to that spent on the generation of the discharge. With an increase in the surface area occupied by the discharge, the hypercirculation effect also increases.