ON THE RELATIVE RECEPTIVITY OF 2D AND 3D SUPERSONIC BOUNDARY LAYER TO STATIONARY DISTURBANCES AT MACH 2

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The paper is devoted to investigation of the relative receptivity of 2D and 3D supersonic boundary layer to the stationary disturbances at Mach 2. The investigations continue the series of experiments that were conducted before [1]. The paper presents the results for blunt and sharp symmetrical square roughness regarding to mean flow distortion and pulsation behavior.

The experiments were conducted in T-325 low noise supersonic wind tunnel of ITAM SB RAS at Mach 2 and unit Reynolds number $Re_1=5\times10^6$ m^{-1}. The model of a flat steel plate with a sharp leading edge and swept wing with sweep angle 45° of the leading edge were used. To create a stationary perturbation various single roughness were used, which was called symmetrical square roughness in [2]. The experiments set-up is presented in Fig. 1. For cases 3 and 4 there are the combined influence of surface roughness and aperture on the surface of the model with a diameter of 0.5 mm for flat plate and 0.4 mm for swept wing. Disturbances in the boundary layer were measured with the help of constant temperature hot-wire anemometer.

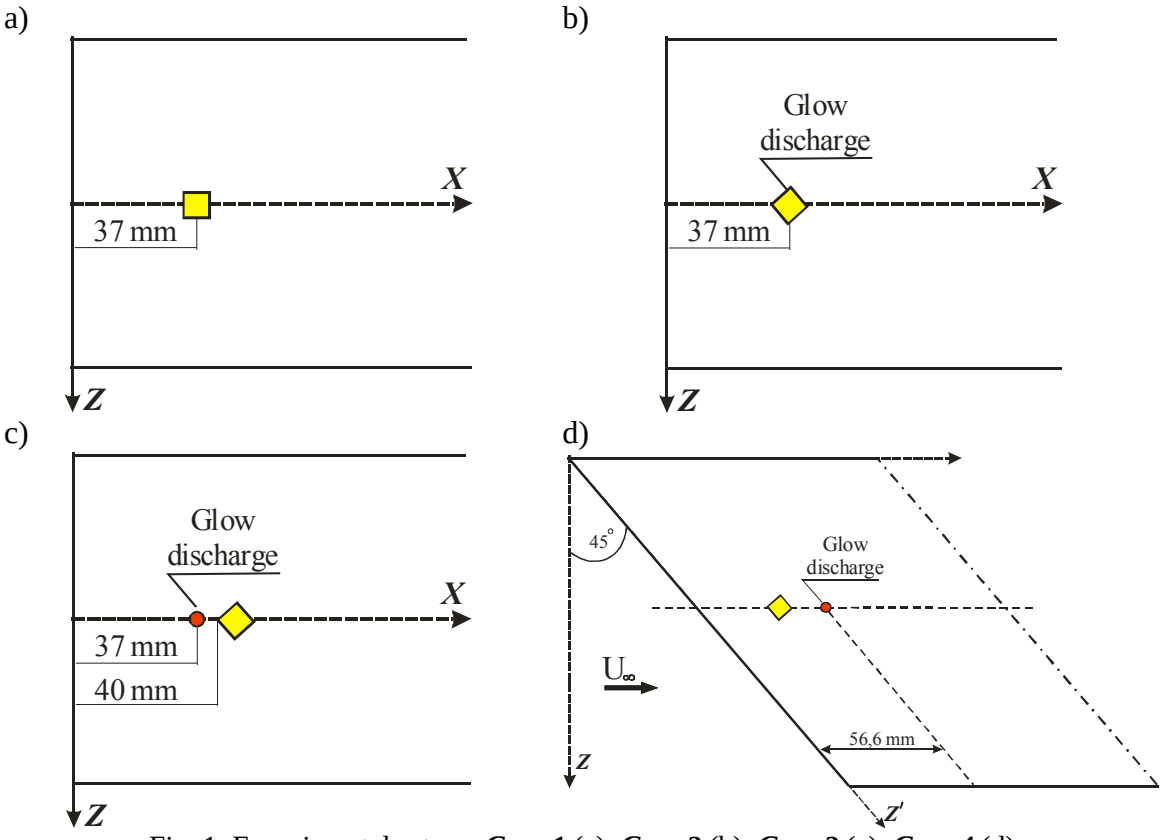

Fig. 1. Experimental set-up: ***Case 1*** (a), ***Case 2*** (b), ***Case 3*** (c), ***Case 4*** (d)

The measurements were made at the different hot-wire position from the model surface. Here is presented a comparison of the mean flow distortion (Fig. 2) and mass flow fluctuations (Fig. 3) only at the layer of maximum mass flow pulsations. It was found out that the shape of stickers has small effect to the amplitude of stationary disturbances, which generated by this roughness. It was obtained that the aperture effects on mean and pulsating flow characteristics. This is especially visible if there is additional distortion of the flow, for example, that was generated by a roughness.

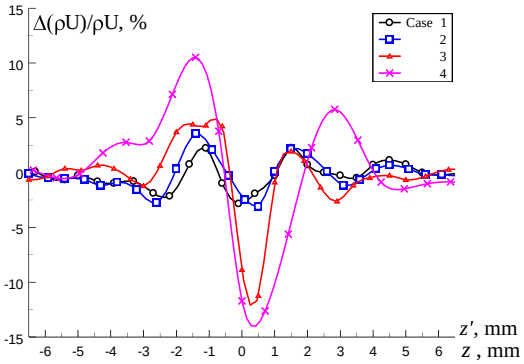

Fig. 2. Comparison of mean flow distortions.

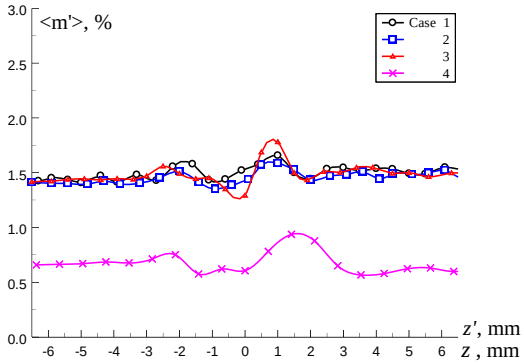

Fig.3. Comparison of mass flow pulsations.

References

1. Panina A.V., Kosinov A.D., Yermolaev Yu.G., Semenov N.V. 2010. Investigation of the effect of transverse inhomogeneity of the flow on the development of the wave packet in a supersonic boundary layer. Vestnik of the NSU. Physics, 5(2): 17-27. (In Russian)

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