VISUALIZATION OF BOUNDARY LAYER TRANSITION BY SHEAR SENSITIVE LIQUID CRYSTALS AT SUBSONIC FLOW VELOCITIES

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ABSTRACT**:** It is necessary to know the position of the laminar-turbulent transition at the model surface in the wind tunnel for recalculating the results of the wind tunnel tests to the conditions of flight. The method of shear sensitive liquid crystals (LC) allows visualization of the transition at the metal models in contrast to TSP method and infrared technique. It has been known for a long time but is rarely used in commercial tests.

Two types of liquid crystals developed at ITAM in Novosibirsk were investigated in this work in order to visualize the laminar-turbulent transition at subsonic flow velocities in range of V = 10-80 m/sec (and corresponding dynamic pressures 57-3922 Pa). The tests were performed in TsAGI in a subsonic wind tunnel T-103 with an open test section. Liquid crystals were applied on a wing panel of a metallic fuselage-wing model. The experimental procedure was based on the registration of the LC color optical response to the flow induced shear stress [2]. Color camera NIKON D3X was used for image acquisition. As it is recommended the investigated surface is illuminated normally and the registering camera is situated up-stream the model at the angle of 30º to the surface. The possibility of changing the positions of the light source and the camera was investigated.

The boundary layer transition was visualized at flow velocities in range of 30-80 m/sec and at α= 0-6º angles of attack. Some results are presented in the figure 1. The camera is situated normally to the model surface here.

The important result of the tests is the fact that it is possible to interchange the light source and the camera, the angle between them is the only effecting aspect. Possibility of maintaining the camera perpendicular to the investigated surface and the light source up-stream the model improves the observation perspective and gives an ability to use this method in wind tunnels with closed test sections where there are no optical windows in the walls up-stream the model as usual.

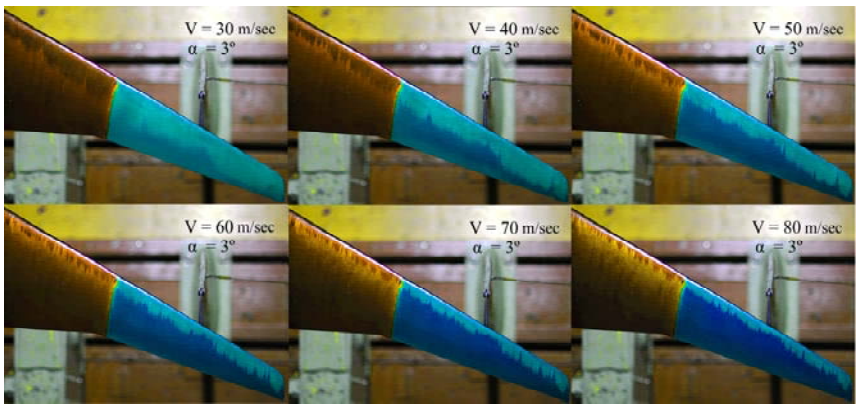

Fig. 1 Visualization of laminar-turbulent transition by shear stress sensitive liquid crystals at different flow velocities, angle of attack α = 3º

References

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