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学位論文題名	Experimental Study on Influences of Riblets on Laminar-Turbulent Transition and Dependence of Wall Turbulence Generation on Disturbance Nature (乱流遷移に対するリブレットの影響と壁乱流生成過程の外乱依存性に関する実験的研究）
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【論文の内容の要旨】

Control of laminar-turbulent transition in boundary layers is one of key technologies to reduce aerodynamic drag of aircraft. Lots of theoretical, experimental and computational studies have been conducted and our knowledge on the mechanism of boundary-layer transition has been much improved for the last few decades. However, some fundamental problems have still remained open to control the transition process. The present thesis deals with some problems related to drag reduction and the underlying mechanisms. The main objective of this thesis is to clarify effects of riblets which are often used for drag reduction of wall turbulence on the instability and transition of boundary layer. Detailed experiments were conducted on the Blasius boundary layer with zero pressure gradient in a low turbulence wind tunnel and a low turbulence channel flow equipment. The thesis consists of five

chapters.

Chapter 1 describes the background and objective of the present study, the related work on the boundary-layer instability and transition, and recent studies on wall turbulence and drag reduction by riblets.

Chapter 2 discusses the experimental work on influence of small-sized riblets on the streamwise growth of Tollmien-Schlichting (T-S) waves, which was conducted in a channel flow. Riblets having triangular ridges and trapezoidal valleys, with a height-to-width ratio of 0.5, were used. The result showed that the streamwise riblets had a strong destabilizing effect and reduced the critical Reynolds number for the linear instability by more than 25%. It was also found that when the riblets were inclined to the streamwise direction, the critical Reynolds number increased as the oblique angle ・ of riblets. For ・≥45°, the riblets had no noticeable influence on the structure of T-S wave and the growth rates were the same as those in the smooth-wall case.

Chapter 3 describes the experimental work on influences of streamwise riblets on the lateral growth of turbulent region localized in span in a boundary layer. The optimal-geometry riblets with drag-reducing size in wall turbulence were used. The lateral spreading angle of the outer edge of laminar-turbulent interface, which approached about 10° in the downstream over the smooth wall, was reduced only by 0.5° by riblets, despite of the destabilizing effect of riblets mentioned in Chapter 2. Thus, the effect of riblets was weak on the lateral turbulent contamination.

Chapter 4 discusses the mechanism of wall turbulence through the experiment on instability and breakdown of a low-speed streak initially forced by disturbances whose frequency-spectrum was similar to that of wall turbulence. Turbulent velocity fluctuations having various spanwise coherencies were used as the forcing signals to excite the streak instability. The results showed that the magnitude of the sinuous instability mode excited was dependent on the initial disturbances, but not very strongly. That is, the magnitude of the sinuous instability mode excited by turbulence components was about 75% of that in the case of anti-symmetric forcing which gave the largest magnitude. Thus the results strongly suggest that fluctuations existing in wall turbulence is rather effective for exciting the streak instability.

Chapter 5 summarizes the important findings described in Chapters 2 to 4.