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Hypersonic boundary layer instabilities affected by various porous surfaces[1] XIAOWEN WANG, XIAOLIN ZHONG, University of California, Los Angeles — Hypersonic boundary layer instabilities of a Mach 5.92 flow over a flat plate affected by various porous surfaces are studied by numerical simulations. Steady base flow is obtained by solving compressible Navier-Stokes equations with a fifth-order shock-fitting method and a second-order TVD scheme. Stability simulations consist of two steps: (1) disturbances corresponding to a single boundary layer wave (mode F or mode S) are superimposed at a cross-section of the boundary layer near the leading edge to show spatial development of the wave; (2) porous coatings are used downstream of the superimposed wave to investigate its effect on boundary-layer instabilities. The results show that porous coating only has local effects on the instabilities of mode S and mode F. In porous region, Mack's first mode is destabilized whereas Mack's second mode and Mode F are stabilized. For felt-metal porous coating, destabilization of Mack's first mode is so significant that disturbances are slightly destabilized when porous coating are put on the whole flat plate. At approximately the same porosity, regular structure porous coating is weaker in first mode destabilization and second mode stabilization than felt-metal porous coating.

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