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A numerical investigation of the impact of surface topology on laminar boundary layers NIKOLAOS BERATLIS, KYLE SQUIRES, Arizona State University, ELIAS BALARAS, The George Washington University — Surface topology, such as dimples or trip wires, has been utilized in the past for passive separation control over bluff bodies. The majority of the work, however, has focused on the indirect effects on the drag and lift forces, while the details of the impact on the boundary layer evolution are not well understood. Here we report a series of DNS of flow over a single row of spherical and hexagonal dimples, as well as, circular grooves. The Reynolds number and the thickness of the incoming laminar boundary layer is carefully controlled. In all cases transition to turbulence downstream of the elements comes with reorientation of the spanwise vorticity into hairpin like vortices. Although qualitatively the transition mechanism amongst different dimples and grooves is similar, important quantitative differences exist: two-dimensional geometries such as the groove, are more stable than three-dimensional geometries. In addition, it was found that the cavity geometry controls the initial thickness of the boundary layer and practically results in a shift of the virtual origin of the turbulent boundary layer. Important differences in the momentum transport downstream of the dimples exist, but in all cases the boundary layer evolves in a self-similar manner.

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