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Near surface flow structure over a dimpled surface with blowing[1]

COLBY BORCHETTA, ALEXANDRE MARTIN, SEAN BAILEY, University of Kentucky — The combined effects of surface roughness with flow injection are of particular interest in understanding the flow over ablative heat-shields, a common form of thermal protection system (TPS) used for atmospheric entry. Stereoscopic, time-resolved particle image velocimetry was used to investigate the near-surface flow over a surface geometry consisting of hexagonal dimples, typical of a TPS. Of particular interest are the modifications made to the flow structures generated by the dimpled elements caused by flow injection through the surface. Without flow injection, inclined flow structures are generated periodically at the upstream edge of the dimples and convected downstream. This behavior is coupled with fluid becoming entrained inside the dimples, recirculating and ejecting away from the surface. When flow injection occurs through the surface, this process occupies a larger region of the flow, extending further from the surface, with a corresponding increase in the size of the convecting structures and increase in turbulent kinetic energy. These features persist over the range of Reynolds numbers investigated, with increasing Reynolds number resulting in increased turbulence and a corresponding broadening of the region of the flow influenced by the surface.

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