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Stretchability of freestanding and polymer-supported serpentine thin films[1] NANSHU LU, SHIXUAN YANG, University of Texas at Austin — High-performance stretchable electronics integrate high-quality inorganic electronic materials such as metal, semiconductor and oxide with deformable polymer substrates. To minimize strains in inorganic materials under large deformation, metal and ceramic thin films can both be patterned into meandering serpentine ribbons which can rotate and twist to accommodate the applied strain. We have systematically investigated the effects of geometry and substrate stiffness on the stretchability of serpentines through both theoretically and experimental means. For freestanding serpentines, closed-form analytical results are obtained and validated by experiments. To investigate the effect of substrates, indium tin oxide (ITO) serpentines are patterned on both polyimide and elastomeric substrates with systematically changing geometries. While stiff substrates such as polyimide almost completely prevents the rotation or twist of the serpentines, soft substrates can provide serpentines with reasonable freedom of rotation and twisting, which yields stretchability of ITO ribbons beyond 100%. But new failure mechanisms have been found on soft substrates.

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