The Structure of an Underetched Convex Mask Corner Explained as the Evolution of a Saddlepoint Vertex

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Anisotropic etching of masked silicon single crystal wafers is widely used in micromachining technology. In this paper it is argued that the structure evolving from an underetched convex mask corner can be perfectly understood and calculated by straightforward application of kinematic wave theory. Previous attempts to predict such structures failed because they were based on an algorithm that, although applicable to protruding and re-entrant vertices, is insufficient to describe saddlepoint vertices. It is important to realize that a convex mask corner is a disguised saddlepoint vertex. For the extended algorithm discussed in this paper, two principles are essential which are not generally recognized: 1) In 3D we have to distinguish protruding, re-entrant and saddle-type point sources. The surface structure evolving from such a point source may contain one or more saddlepoint vertices. 2) Saddlepoint vertices can act as a (topological) velocity source. This behavior can be recognized by the concurrence of more than three edges in the vertex. These new principles are applied to explain the structure of the underetched mask corner on a Si\{100\} wafer etched in potassium hydroxide (KOH). Under specific conditions, this structure includes three velocity source saddlepoint vertices, three ordinary saddlepoint vertices and four protruding vertices.