If a thin layer of copper or gold is spread on a silicon substrate, for the purpose of producing, for example, chips, it may well happen after some time, due to aging and wear, that the thin layer starts to detach from the underlying substrate, giving way to exposed (“dried”) regions on the silicon substrate, which hinders proper functioning. In order to study this phenomenon, we should like to adopt a mathematical model which is sufficiently simple, yet sufficiently accurate to allow us to probe this behavior. For this purpose it is reasonable to consider the interface between the copper layer and the surrounding gas atmosphere as a smooth manifold (a Riemannian manifold) with a boundary whose motion is governed by surface diffusion (Mullins, 1958), namely

$$V_n = -B\Delta_s\kappa.$$  

Here $V_n$ is the normal velocity of the manifold, $\kappa$ is its mean curvature, $\Delta_s$ is the Laplace-Beltrami operator, and $B$ is the “Mullins” coefficient. During the workshop we shall try to formulate well-posed mathematical problems designed to describe "drying streak propagation waves" and "self-similar dry region propagation." If we succeed, we shall proceed to the next step which is trying to solve such problems.

**Motion of Manifolds by Surface Diffusion**

Amy Novick-Cohen, Mathematics

Prerequisites: Intro Applied Math, ODEs (Madar Aleph). Potentially helpful: Intro PDEs, Differential Geometry.

\[ V_n = -B \Delta_s \kappa \]

Figure 2: AFM micrographs of one and the same region of a thin (20 nm) Mo film on a sapphire substrate after annealing at 940° C for (a) 30 min, (b) 45 min, (c) 60 min, (d) 120 min. Scale bar is 1 μm. From E. Rabkin, Mat. Sci. Eng., Technion.