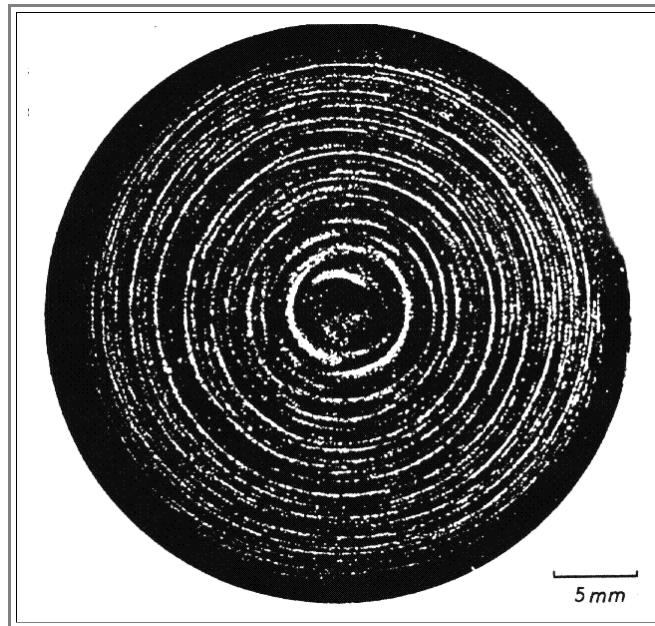


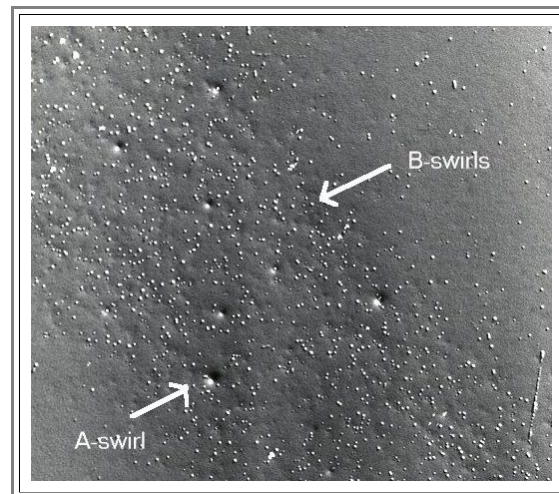
Swirl Defects

Swirl defects were discovered in the seventies in large dislocation-free Si crystals grown for micro electronic applications. They occur in two variants, the so-called **A-swirl** and **B-swirl** defects. The following picture shows a photograph of a Si wafer that was preferentially etched to delineate the defects obtained by illuminating from the side (so that only light scattered at the defects enters the lens of the camera).

- The typical spiral or swirl-like pattern explains the name of the defects.



- Looking at the etch pattern with a microscope at high magnifications shows that there are a lot of small defects (the **B-swirls**; white dots) and a much smaller number of larger defects (**A-swirls**; the black-white contrasts). Quantitative evaluation of the micrograph shows that the **B-swirls** are delineated as small and shallow pits whereas the **A-swirls** are delineated as hillocks.



Swirl defects are generated by the agglomeration of point defects while the crystals cools. The Si crystal growing industry soon learned how to grow crystals without swirl defects - without ever understanding precisely what they were.

- But that did not mean that the crystals were defect free - it only meant that the methods employed then did not detect what was there. With new methods, defects reappeared, now called D-defects and bother the chip industry.
- [More about swirls](#) can be found in a original research paper (in German) in the link.