

Amelinckx S & Dekeyser W. The structure and properties of grain boundaries. *Solid State Phys.* 8:325-499, 1959.
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This paper is one of the first surveys of the status in the 1950s of the dislocation theory of small-angle boundaries and of the corresponding observations. Emphasis was laid on the geometrical aspects of the theory and on "direct" observation methods of dislocation networks, such as decoration methods, to which the authors have contributed. [The SC⁹ indicates that this paper has been cited in over 135 publications.]

Decoration—A Scientific Curiosity

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It is not straightforward for an author to find out why one of his papers has been more successful in attracting attention and in stimulating research than his other papers, some of which he may actually consider more valuable. I suspect that the widespread interest generated by this paper must stem from the fact that it was the first survey to present a coherent picture of so-called "direct" evidence for the dislocation structure of small-angle grain boundaries.

In the 1940s and early 1950s, F.C. Frank¹ and William Shockley and W.T. Read^{2,3} had proposed detailed models: hexagonal and square networks of screw dislocations for twist boundaries and parallel arrays of edge dislocations for tilt boundaries. Convincing theoretical arguments were thus available showing that small-angle grain boundaries could be described as networks of dislocations.⁴ However, "visual" evidence was lacking. During the same period Alan H. Cottrell and B.A. Bilby⁵ had shown that

impurities interact with the stress fields of dislocations, leading to the formation of impurity "clouds" around them, resulting ultimately in the heterogeneous nucleation of precipitates in the dislocation cores. A theoretical basis was thus available supporting the idea that it ought to be possible to visualize dislocation lines by revealing rows of precipitates "decorating" them. This is what I did as a postgraduate student of Professor Dr. W. Dekeyser at the State University of Ghent.^{6,7} The photographs actually represent patterns of silver particles, but since these are preferentially nucleated on dislocation lines, it was justified to pretend that one was looking at the dislocation lines themselves.

The method had severe limitations, however. It was only possible to visualize pinned, "dirty" dislocations after heat treatment—and, moreover, only in optically transparent crystals, the resolution being limited mainly by the precipitate size. Nevertheless, the method was applied to a limited number of crystals; it required the development of a specific procedure for each crystal.⁸⁻¹¹

With the advent of transmission electron microscopy, "clean" dislocations could be imaged by their strain field in virtually all materials and with a much better resolution.^{12,13} As a result, light optical methods were abandoned and the number of papers in which decoration methods were used has remained very limited. Decoration was reduced to a scientific curiosity rather than becoming a routine method to visualize dislocations.

The paper under discussion also contained a theoretical analysis of the many observed dislocation configurations, as well as a systematic derivation based on Frank's formula¹⁴ of the possible small-angle boundaries, that can be constructed from given families of dislocations.

Presumably it was the combination of the theoretical considerations and their "direct" visual confirmation that was the reason for the success of the paper.

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4. Amelinckx S. Etchpits and dislocations along grain boundaries, sliplines and polygonization walls. *Acta Met.* 2:848-53, 1954. (Cited 85 times.)
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