

Milnes A G & Feucht D L. *Heterojunctions and metal-semiconductor junctions*.
New York: Academic Press, 1972. 408 p.
[Carnegie-Mellon University, Pittsburgh, PA]

The electrical and electro-optical properties of metal-semiconductor junctions and of junctions of two different semiconductors are discussed. The book also reviews high-yield negative-electron-affinity photocathodes and electron-emitters, chemical vapor deposition and liquid-phase epitaxy for growth of heterojunctions and ohmic contacts and etching technology. [The SCI® indicates that this book has been cited in over 410 publications since 1972.]

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"After a number of years in Britain working on magnetic problems, I joined Carnegie Institute of Technology in 1957. Silicon bipolar transistors had just become available and excitement in the field was high because of the commercial implications. The key decision for us, at that time, was whether to orient our research around silicon and the main industrial thrust of that era, or to bypass this and work on a technology that we hoped might be of importance seven or ten years from our start.

"My colleague, Don Feucht, and I chose the leapfrog approach and began work on heterojunctions (electrical junctions of two different semiconductors or of metals and semiconductors). We enjoyed this because it allowed experimentation with a whole range of different semiconductors. (On reflection, however, I believe we could have made the choice to stay with silicon and still have made significant contributions—since the silicon field itself became wider than at first expected.)

"By the late 1960s there had been breakthroughs elsewhere, particularly with heterojunction injection lasers of gallium arsenide, and the literature was growing rapidly both in materials processing and in device performance. The time had obviously come to review the field and create some perspective and order. This work was soon picked up for translation into Japanese and Russian and so became a starting point for workers in many countries. In the ten years since the volume appeared, industrial laboratories have carried heterojunction studies to levels of refinement (for instance, with perfection of lattice matching by the use of ternary and quaternary compounds) that exceed our wildest imaginings. The need for light emitting and detecting devices for optic fibers for communications is one force now driving the subject. A second factor is the development of subtle uses of heterojunctions such as quantum-well structures and modulation doping for high frequency gallium arsenide transistors.

"A reviewer of the manuscript prior to publication declared that although the discussion of metal-semiconductor junctions was of value, he wasn't too sure that heterojunctions would be more than laboratory curiosities! Should universities try to leapfrog current technology? Were we very far-sighted in our choice? I would like to think so, but more probably we just took a reasonable gamble and nature cooperated.

"The monograph has been so frequently cited because it was timely and provided an orderly focus for others starting in the field. We still do not understand heterojunction interfaces¹ or metal-semiconductor interfaces² as well as we would like, but we can certainly make them work for us."

1. Kroemer H. Heterostructure bipolar transistors and integrated circuits. *Proc. IEEE* 70:13-25, 1982.

2. Brillson L J. The structure and properties of metal-semiconductor interfaces. (Whole issue.) *Surface Sci. Rep.* 2(2), 1982. 203 p.