

Bullis W M. Properties of gold in silicon. *Solid State Electron.* 9:143-68, 1966.
[Texas Instruments Inc., Dallas, TX]

The doping characteristics, recombination properties, solubility, and diffusion of gold in silicon are reviewed. Although the gross features of these properties appear to be reasonably well understood, much detailed information relevant to semiconductor device fabrication remains to be obtained. [The SCI® indicates that this paper has been cited in over 110 publications since 1966.]

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"The work leading to this paper was carried out at Texas Instruments in 1964 and early-1965. I had just been assigned to undertake research on silicon materials problems related to the manufacture of high performance transistors. During the construction of the lab equipment necessary for the planned experimental studies, my good friend and colleague, Jay Lathrop (now at Clemson University), suggested that I prepare a review of the properties of gold in silicon.

"This suggestion was most timely. Then, as now, the material properties of silicon were being pushed to the limit in order to obtain ever greater performance. Gold, as an impurity, was of

particular interest because of its effectiveness in controlling carrier recombination in both n- and p-type silicon.

"The various properties of gold—diffusion, solubility, and electrical activity—had been under active study since the mid-1950s in a number of laboratories.^{1,2} Published reports and presentations at various professional society meetings appeared regularly. Although an image of the critical characteristics was beginning to emerge, the reports were scattered and frequently contradictory, and the incorporation of gold in silicon was more an art than a science.

"The topic itself was a logical extension of my previous work at Texas Instruments which had been concentrated on the electrical properties of deep levels in III-V compounds. In addition, several of my colleagues who were particularly knowledgeable in other aspects of the topic broadened my knowledge through numerous stimulating discussions.

"The paper itself was a combination of literature assessments and original contributions which taken together provided a comprehensive review of the then existing state of the art related to gold in silicon. This completeness of coverage is probably one of the reasons that the paper has been frequently cited. Another very likely reason is that the interest in this subject continues at a high level even today. Over the intervening years, much new information has been developed. Although much of the early data is now obsolete and many of the early interpretations have been shown to be incorrect,³⁻⁵ the review still retains a certain historical value."

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2. Collins C B, Carlson R O & Gallagher C J. Properties of gold-doped silicon. *Phys. Rev.* 105:1168-73, 1957.
3. Gösele U, Frank W & Seeger A. Mechanism and kinetics of the diffusion of gold in silicon. *Appl. Phys.* 23:361-8, 1980.
4. Hbl M, Lietz M & Sittig R. Diffusion of gold in silicon. *J. Electrochem. Soc.* 129:1579-87, 1982.
5. Stolwijk N A, Schuster B, Hölzl J, Mehrer H & Frank W. Diffusion and solubility of gold and silicon. *Proceedings of the 12th International Conference on Defects in Semiconductors, August 1982, Amsterdam.* To be published.