

# NASA TECH BRIEF



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## Impurity Diffusion Process for Silicon Semiconductors Is Fast and Precise

**The problem:** To produce precision silicon semiconductor junctions economically by accelerated fabrication techniques. The present method involves a dopant-rich oxide that diffuses impurity atoms into a silicon wafer for a given time at a given temperature. Because the oxide is grown from the silicon wafer, impurities already in the silicon wafer may act as counterdopants to the desired impurities. Thus the concentration of the dopant in the oxide cannot be controlled. This method is also time consuming.

**The solution:** A process in which the oxide is deposited rather than grown on the silicon wafer and a controlled concentration of impurity atoms in gaseous form is simultaneously introduced into the reaction. This process is more accurate and requires much less time at elevated temperatures.

**How it's done:** A silicon dioxide ( $\text{SiO}_2$ ) layer is deposited on the silicon wafer by either steam oxidation or thermal decomposition of  $\text{CO}_2$  and  $\text{SiCl}_4$  in the presence of hydrogen. A window is cut by photoengraving in the  $\text{SiO}_2$  layer in the region where the junction is desired and a second  $\text{SiO}_2$  layer is deposited in this region as a gaseous dopant is simultaneously introduced into the reaction. Dopants used

are  $\text{B}_2\text{H}_6$  (p type),  $\text{PH}_3$  (n type), and  $\text{AsH}_3$  (p type). The gas is metered into the reaction under much finer control than is possible with liquid or solid impurity sources. A shorter time at elevated temperatures is required and results in less migration of prior diffused impurities within the silicon.

**Notes:**

1. This invention should be of interest to manufacturers of semiconductor devices.
2. Inquiries concerning this invention may be directed to:

Technology Utilization Officer  
Goddard Space Flight Center  
Greenbelt, Maryland, 20771  
Reference: B65-10300

**Patent status:** NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

Source: Raymond M. McLouski and Glenn W. Skouson of Westinghouse Electric Corporation under contract to Goddard Space Flight Center (GSFC-397)

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