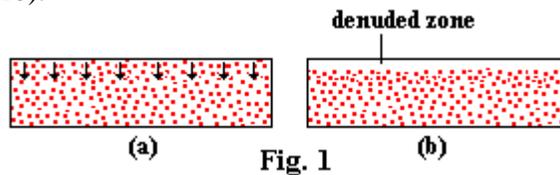


Gettering

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To assure adequate performance of devices and circuits built into the silicon wafer, its very top, near-surface region should be free from metallic contaminants (impurities) and structural defects. At the same time the requirements in this regard concerning bulk of the wafer, i.e. region away from the surface, are more relaxed as this region is not involved in the operation of devices comprising an integrated circuit. To create such a desirable distribution of impurities and defects both will have to be displaced from the near-surface region of the wafer into its bulk. To realize this goal wafers prior to their use in the IC fabrication process are subjected to additional operations aimed at the formation of a *denuded zone*, i.e. defect and contamination-free layer at the surface of the wafer. The procedure involved is known as *gettering*. In the course of gettering impurities are forced to move away from the top surface into the bulk of the wafer and are trapped there permanently (Fig. 1a). As a result, an impurities free thin region is formed at the top surface of the wafer (Fig. 1b).



Effectively, “gettering” is a three-step process in which impurity is (i) released from its site, (ii) diffuses toward a bulk, and (iii) is captured at the getter site away from the top surface. Practical gettering processes are designed to trigger in the desired sequence each of these three steps. The step (i) is always triggered thermally, and hence, gettering processes always involve exposure of the wafer to high temperature. Based on the way remaining interactions are enforced, step (ii) in particular, gettering processes are divided into two categories of *intrinsic (internal)* and *extrinsic (external)* gettering processes.

Intrinsic gettering – The concept is applicable to wafers manufactured from the Czochralski (CZ) grown single-crystal silicon. Almost all Si wafers used in IC technology are CZ wafers. Due to the nature of the processes, CZ grown silicon contains relatively high concentrations of dissolved oxygen. Internal gettering is using this oxygen to enforce precipitation of metallic impurities, such as copper, not at the wafer surface, but in its bulk. Preparatory step in this case is a thermal treatment causing precipitation of the excess oxygen which, for a variety of reasons related to the specific properties of oxygen in silicon, forms oxygen precipitates in the bulk of the wafer rather than at its surface. Those oxygen precipitates act then as a gettering sites for metallic impurities, copper for instance, attracting them away from the top surface. The process involves a series of carefully executed thermal steps performed in a predetermined sequence.

Extrinsic gettering –In contrast to intrinsic gettering, which uses intrinsic properties of CZ Si to accomplish gettering, the idea behind extrinsic gettering involves purposely created disorder in the crystal at the back surface of the wafer by external means. Once created, a disorder of any kind will tilt the balance in metal precipitation preferences between top and back surfaces toward the latter. Thus, a region at the back surface of the wafer will act as a “sink” for metallic impurities in the wafer drastically reducing their concentration at the top surface. This will happen once temperature of the wafer is increased making rapid diffusion of metallic impurities toward the stressed region possible. A ‘disorder of the crystal structure at the back surface can be created in the variety of ways including damaging of the surface by ion implantation, exposure to high energy laser beam, or deposition of a highly disordered poly-silicon on the back surface of the wafer. Once such as disordered region is created, a subsequent thermal treatment completes the external gettering process.