Self-healing in semiconductors

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Recently, important advances are reported on self-healing in solid-state materials after mechanical damage. Microdamage caused by stress loading would normally grow larger and larger, finally leading to destruction of the material. In case of self-healing, the microdamage disappears (dissolves) over time as the result of a room-temperature diffusion process [1]. Such phenomena are being studied in various classes of materials such as metals, polymers, ceramics and concrete.

Moving to silicon devices, the damage we care about has a somewhat different nature: we typically study damage after electrical rather than mechanical stress, and this damage occurs at the atomic scale. Examples include interface states and bulk traps. Self-healing of these defects does not occur at room temperature, which (I speculate) we can attribute to the low rate of self-diffusion of silicon. But atomic-scale damage in silicon is readily annealed out at a few hundred ^{o}C, depending on the annealing ambient (see *e.g.* [2, 3] and references therein). So one could argue that silicon is a self-healing semiconductor at elevated temperature.

Work on CIGS semiconductors has however consistently shown that, after heavy radiation damage, their electrical properties can recover fully under normal operating conditions [4]. Can similar recovery occur upon different stress conditions, such as electrical stress? And can we use these results to make silicon self-healing, or should we rather adopt chalcopyrites as the new semiconductors of choice for harsh environments?

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