Laser annealing of semiconductors, what we learned 35 years ago, and why it still matters today

George K. Celler

Rutgers University, New Brunswick, NJ 08901, USA

Laser annealing of ion implanted semiconductors was first investigated in the Soviet Union in the mid 1970s, and became a very active research pursuit in the rest of the world after the first US-USSR conference on ion implantation that was held in Albany, NY, USA in the summer of 1977. A conference in Catania, Italy, one year later was possibly the first international conference that was fully devoted to laser annealing. This was followed by a Laser Annealing Symposium of the Materials Research Society in November of 1978 in Boston, which became the first in a long series of the MRS symposia devoted to laser-solid interactions and laser processing of semiconductors.

Investigations of laser annealing led to a much better understanding of the physics of crystal growth, rapid solidification and solute trapping, impurity segregation from the melt, melt and solidification kinetics, crystallographic defects annihilation, phase transitions, conditions required for laser induced amorphization, and other phenomena related to rapid heating and cooling.

Additional excitement at conferences was generated by some people, who argued that silicon irradiated with 5-50 ns pulses is annealed not through a process of melting and recrystallization, but instead by plasma excited by a high density of incident photons. It took a few years to fully refute this controversy, but it motivated many interesting experiments that provided data of great scientific significance.

In practical terms, laser annealing in 1970s and 80s was far ahead of any real need of the semiconductor industry, but it stimulated interest in Rapid Thermal Processing on a 1-10 sec timescale that quickly became indispensable in the electronic device fabrication. Currently, with transistor gate lengths in the 10-20 nm scale, laser annealing is back in vogue, and the data from 35 years ago are as significant as ever.