Process Simulation for Laser Recrystallization

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Laser recrystallization of thin films is one of the key technology processes for obtaining base materials for SOI and 3D applications. To support our experimental process devolopment we are involved in 3-dimensional heat transport simulation and especially in modeling of crystal growth during laser recrystallization.

Simulation of energy absorbtion of laser beam

Reflection, transmission and absorption by a multilayer optical stucture was calculated using approximation of Maxwell eq. for homogenous layers.

Simulation of heat transport

The solution of 3-dimensional heat transport problem is based on FD method. The non-linearity of H-T dependence at the melting point represents the main numeric problem.

Modeling of formation of grain boundary defects

Based on modeling of the facetted growth of Si films we used Monte-Carlo simulations to describe the grain boundary formation at any given temperature distribution. The simulations are agreeable with experimental results, both for beam shaping technique, as well for application of so called integrated absorbers.

Based on the simulation results we introduced a new method called micro absorber to suppress the formation of grain boundaries during laser recrystallization. Areas free of grain boundaries of up to 100 μm x 50 μm are obtained in our first experiments.

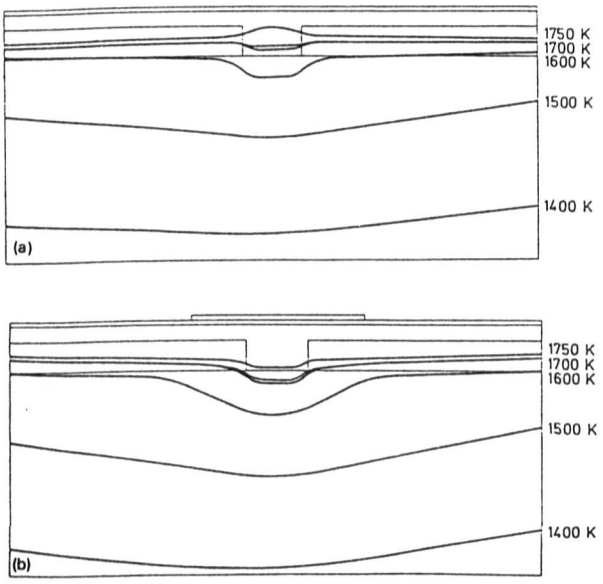

Fig.1 Simulated temperature distribution near a seeding hole in cross section: a) without integrated absorber covering the seeding hole, the silicon in seeding hole is not completely molten; b) with integrated absorber, the silicon in seeding hole is completely molten.

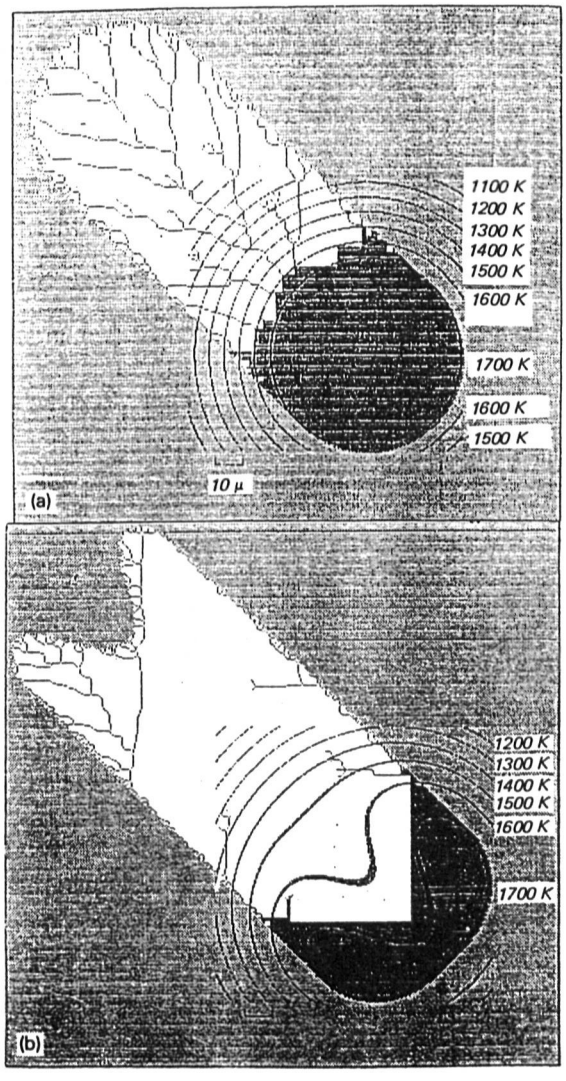

Fig.2 Simulated network of grain boundaries of Ar-laser recrystallized silicon film a) using Gaussian shaped beam and b) horse shoe shaped beam.

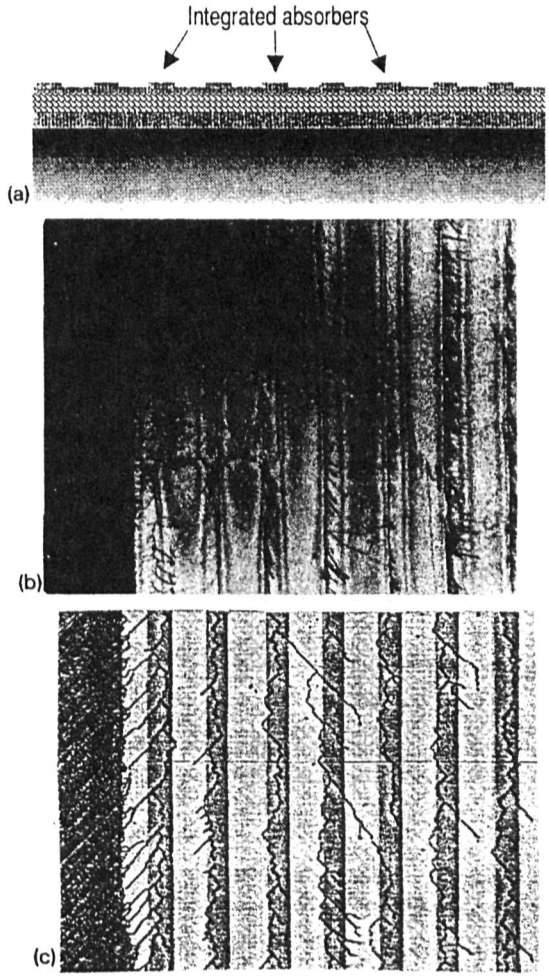

Fig.3 a) Cross section of a structure for Laser recrystallization unsing integrated absorbers for entrainment of grain boundaries, b) experimental result, c) simulation.

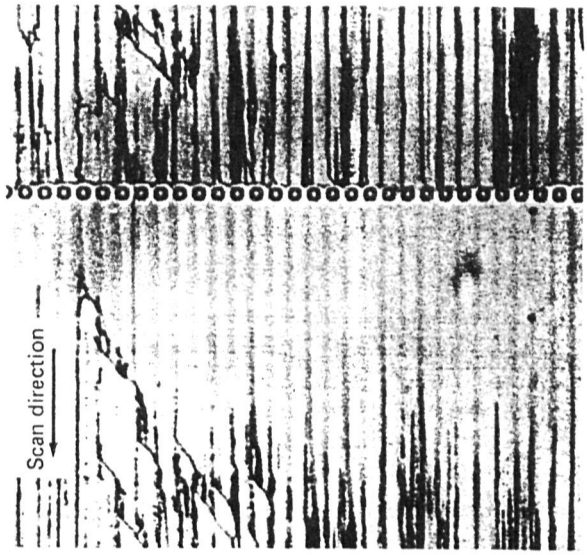

Fig.4 Laser recrystallized Si film using micro absorbers. Size of seeding holes: 2μ x 2μ; the pitch of integrated absorbers: 4μ.