Materials Science & Engineering Master's Defense

Effect of Microwave Annealing of Low Energy Boron Implanted and Phosphorus Implanted Silicon

School for Engineering of Matter, Transport and Energy

Zhao Zhao

Advisor: Terry Alford

abstract

The quick process and less end-of-range diffusion effects demonstrate that susceptor-assisted microwave anneal is an efficient processing alternative for electrically activating dopants and removing ion implantation damage in ion implanted semiconductors. Sheet resistance and Hall measurements provide evidence of electrical activation. Raman spectroscopy and ion channeling analysis monitor the extent of ion implantation damage and recrystallization. The defects of boron implanted silicon during annealing is observed by Rutherford backscattering spectrometry and investigated by cross-section transmission electron microscopy. Comparison of end-of-range diffusion in microwave annealing and rapid thermal annealing (RTA) is done with the use of secondary ion mass spectroscopy. Results from the microwave annealed samples show that almost no diffusion occurs during time periods necessary for complete dopant activation and recrystallization. When annealing boron implanted silicon, the dissolution of small dislocation loops and growth of large dislocation loops result in undesired crystalline quality and hinder the electrical activation process. Compared to boron implanted silicon, the phosphorus implanted samples experience a much faster activation process and achieve better electrical properties. An investigation of the contribution of SiC susceptor and Si self-heating in the microwave anneal is also performed. At different stages of the microwave anneal, the main contribution to the sample's temperature rise changes from Si self-heating (by microwave absorption) to conductive heating (from SiC susceptor).

July 24, 2013; 10:30 AM; ECG 214