

Si, Ge and SiGe Nanocrystals for Memory Device and Solar Cell Applications

S. Ağan

University fo Kırıkkale, Department of Physics, 71450 Kırıkkale, Turkey

We have proposed to produced nano size materials which are promised for technological applications. In this aim, thin films have been grown using by Plasma Enhanced Chemical Vapor Deposition (PECVD). The grown films have been annealed to form nanocrystals inside the matrix for different temperature ranges. Due to annealing processes Si, Ge, SiGe nanocrystals in SiO₂ and Si₃N₄ thin films and size distributions have been investigated using by Transmission Electron Microscopy (TEM) and Raman Spectroscopy. SiO₂ and Si₃N₄ thin films have been grown with GeH₄, SiH₄ and N₂O gases at different flow rates using plasma chamber. The results show that nanocrystals sizes depend on annealing time, temperature and flow rates. Optical properties have been searched for these nanocrystals using by Photoluminescence (PL) and FTIR Spectroscopy.

The Metal-Oxide-Semiconductor (MOS) Capacitors with Ge nanocrystals embeded in oxide have been fabricated to investigate the charge trapping effect Ge nanocrystals. The hysteresis phenomenon has also been observed in C-V measurements. The highest obtainable memory value with multilayer Ge nanocrystals was 0.52 V. Retention times were also checked for our devices. The Ge nanocrystals flash memory cells with this structure could be a promising candidate in future nonvolatile memory applications. On the other hand, our samples with Si nanocrystals formed in Si₃N₄ matrix showed good results to use for solar cells application to increase efficiency.