Nanostructured surfaces
Comprehensive study of silicon nanoinclusions structures in silicon oxynitride matrix after high-temperature annealing for the photovoltaic

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Dielectric films with embedded silicon oxide nanoclusters are widely used as antireflective, protective coatings, as well as converter of high-energy part of the spectrum to radiation energy close to band-gap of silicon material. Particular attention is attracted to oxynitride films, because the presence of the nitrogen strongly affects their physical characteristics.

This work is devoted to experimental and theoretical study of nonstoichiometric oxynitride silicon films $SiO_{1.0}N_{0.23}$. Results of the investigation of $SiO_{1.0}N_{0.23}$ films by PL, Raman and IR spectroscopies after thermal annealing in the temperature range 400-1100 ^{O}C in N_2 ambient for 1 hour are presented.

From the comparison of IR spectroscopy measurements and theory characteristics of hydrogen effusion were obtained, namely the mean value and the mean-square deviation of the energy distribution as well as the attempt frequency for hydrogen effusion are compatible with those obtained for the depassivation of P_bH centers at the Si/SiO_2 interface. Simultaneously, Raman and PL data demonstrate that at any rate partial phase separation in these films with formation of amorphous Si nanoinclusions takes place at the temperature as low as 400°C. The gradual transformation of amorphous into crystalline Si inclusions with the increase of annealing temperature is demonstrated. Unlike Si rich Si oxide films, in studied samples mentioned transformation still occurs at the temperature as high as 1100°C.

1. *Sarikov A., Voitovych M., Lisovskyy I., Naseka V., Hartel A., Hiller D., Gutsch S., and Zacharias M.* Characteristics of hydrogen effusion from the Si–H bonds in the Si rich silicon oxynitride films for nanocrystalline silicon based photovoltaic applications // Adv Mater Res.-2014.**-854.-**P. 69-74.
2. *Naseka V., Nasieka Iu., Voitovych M., Sarikov A., Lisovskyy I. and Strelchuk V.* Photoluminescence and Raman scattering behavior of Si rich silicon oxynitride films annealed at different temperatures // Solid State Phenomena.-2005. **205-206.**-P. 492-496.