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Raman study of light-emitting SiN_x films grown on Si by low-pressure chemical vapor deposition

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ABSTRACT

Si-rich silicon nitride (SRSN) films were deposited on Si wafers by low pressure chemical vapor deposition (LPCVD) technique and, subsequently, annealed at (800 – 1200) °C to form Si precipitates. The composition of SiN_x films was measured by Rutherford backscattering spectrometry (RBS). Two sets of samples differed by the amount of excessive Si (Si_{exc}) in silicon nitride were studied. Evolution of Si nanoclusters from amorphous to crystalline ones during high temperature treatment was examined by Raman scattering (RS) spectroscopy. The amorphous Si clusters were already revealed in as-deposited SiN_x while the annealing results in their crystallization. The crystalline nanoprecipitates are only registered in nitride films after annealing at 1200 °C. A dependence of Raman scattering intensity from the Si wafer on the temperature of annealing of SiN_x/Si structures was revealed. This information was used to explain the phase transformations in SRSNs during high temperature treatments. The peculiarities of photoluminescence (PL) spectra for two sets of Si-rich SiN_x films are explained

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