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Light Emission Enhancement of Silicon Nanocrystals by Gold Layer

Authors : R. Karmouch

Abstract : A thin gold metal layer was deposited on the top of silicon oxide films containing embedded Si nanocrystals (Si-nc). The sample was annealed in gas containing nitrogen, and subsequently characterized by photoluminescence. We obtained 3-fold enhancement of photon emission from the Si-nc embedded in silicon dioxide covered with a Gold layer as compared with an uncovered sample. We attribute this enhancement to the increase of the spontaneous emission rate caused by the coupling of the Si-nc emitters with the surface plasmons (SP). The evolution of PL emission with laser irradiated time was also collected from covered samples, and compared to that from uncovered samples. In an uncovered sample, the PL intensity decreases with time, approximately with two decay constants. Although the decrease of the initial PL intensity associated with the increase of sample temperature under CW pumping is still observed in samples covered with a gold layer, this film significantly contributes to reduce the permanent deterioration of the PL intensity. The resistance to degradation of light-emitting silicon nanocrystals can be increased by SP coupling to suppress the permanent deterioration. Controlling the permanent photodeterioration can allow to perform a reliable optical gain measurement.

Keywords : photodeterioration, silicon nanocrystals, ion implantation, photoluminescence, surface plasmons
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