View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Servicio de Coordinación de Bibliotecas de la Universidad Politécnica de Madrid

Room temperature photoluminescence of InGaAs Surface Quantum Dots

J.M. Ulloa, K. Yamamoto, A. Guzmán, A. Hierro

Instituto de Sistemas Optoelectrónicos y Microtecnología (ISOM), Departamento de Ingeniería Electrónica, ETSI de Telecomunicación, Universidad Politécnica de Madrid, Ciudad Universitaria s/n, 28040 Madrid (Spain)

Self-assembled InGaAs quantum dots show unique physical properties such as three dimensional confinement, high size homogeneity, high density and low number of dislocations. They have been extensively used in the active regions of laser devices for optical communications applications [1]. Therefore, buried quantum dots (BQDs) embedded in wider band gap materials have been normally studied. The wave confinement in all directions and the stress field around the dot affect both optical and electrical properties [2, 3]. However, surface quantum dots (SQDs) are less affected by stress, although their optical and electrical characteristics have a strong dependence on surface fluctuation. Thus, they can play an important role in sensor applications [4].

In this work, we study the photoluminescence response of $In_{0.5}Ga_{0.5}As/GaAs$ quantum dots. A sample with two QD layers, one buried and the other one on the surface, is compared with another sample with only one layer of $In_{0.5}Ga_{0.5}As$ QDs on the surface. Buried quantum dots and surface quantum dots are grown under the same conditions. The photoluminescence spectrum corresponding to the sample with two layers, shows two peaks separated 220 meV (see figure 1a). The sample with only one layer on the surface shows a single peak (see figure 1b). This, clearly demonstrates that the low energy emission in the PL spectra originates from the surface quantum dots.

We perform an analysis of the optical properties of the surface quantum dots depending on different parameters including their composition and temperature. The strong luminescence intensity observed at room temperature is very promising for the future development of sensors.

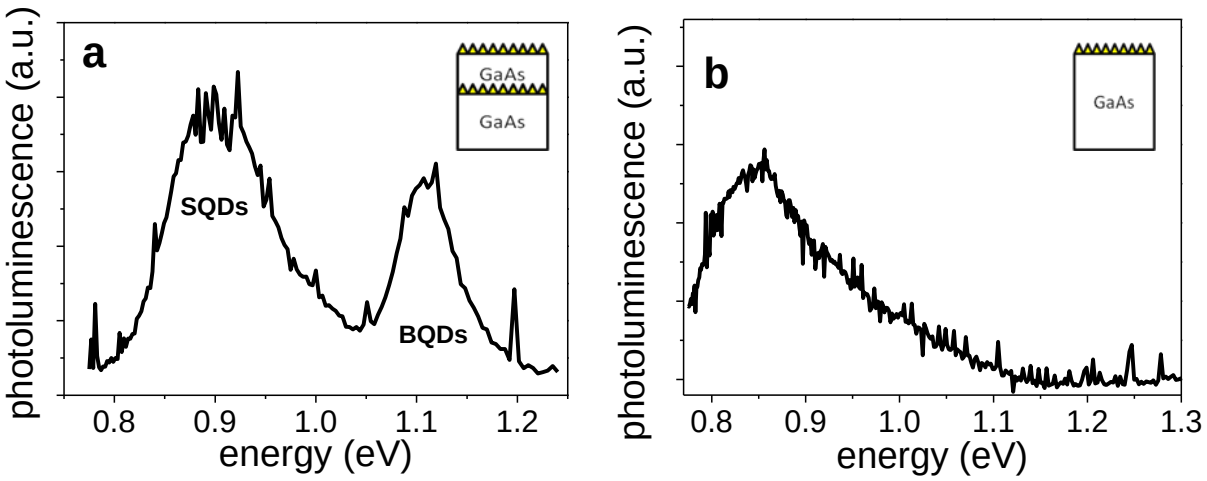

Figure 1. (a) Photoluminescence spectra at room temperature of both buried quantum dots (high energy peak) and surface quantum dots (low energy peak). (b) Emission peak of surface quantum dots.

[1] H. Saito, K. Nishi, I. Oguna, and Y. Sugimoto, Appl.Phys.Lett 69, 3140 (1996)
[2] H. Saito, K. Nishi, S. Sugou, Appl.Phys.Lett 73,2742 (1998)
[3] Z.L.Miao, Y.W. Zhang, S.J. Chua, Y.H. Chy, P.Chen, and S.Tripathy, Appl.Phys.Lett. 86,031914 (2005)
[4] C.Y.Zhang, H.C. Yeh, M.T. Kuroki, and T.H. Wang, Nat.Mater. 4, 826 (2005)