

## LETTER TO THE EDITOR

# Porosity-induced gain of luminescence in CdSe

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Received 26 August 2004, in final form 27 September 2004

Published 3 November 2004

Online at [stacks.iop.org/SST/19/L121](http://stacks.iop.org/SST/19/L121)

doi:10.1088/0268-1242/19/12/L04

## Abstract

Porous CdSe layers have been produced by anodic etching of crystalline substrates in a HCl solution. Anodization under *in situ* UV illumination resulted in the formation of uniformly distributed parallel pores with a diameter of 30 nm, stretching perpendicularly to the initial surface. At the same time, pronounced nonuniformities in the spatial distribution of pores were evidenced in samples subjected to anodic etching in the dark. Gain of luminescence was observed in some porous regions and attributed to the formation of ring microcavities for light in the porous network.

More than a decade ago porosity emerged as an effective tool for controlling properties of semiconductor materials. Besides porous Si, III–V semiconductors in the porous form were extensively studied [1]. Porosity-enhanced phenomena such as optical second harmonic generation and Terahertz emission have been reported [2–4]. One of the most intriguing observations is the porosity-induced increase of cathodoluminescence (CL) intensity in GaP [5]. In spite of the huge surface inherent to porous matrix, gallium phosphide in the porous form shows CL intensity one order of magnitude higher than that of bulk crystals under the same excitation conditions [5]. On the other hand, relatively little attention has previously been paid to the study of porosity-induced changes in the properties of II–VI compounds. The effect of photoetching on photoluminescence (PL) of n-CdSe was studied many years ago [6], but the authors claimed the formation of etch pits rather than pores. Formation of porous network which extends more than 100  $\mu\text{m}$  below the initial surface was recently reported in p-Cd<sub>1-x</sub>Zn<sub>x</sub>Te by Erné *et al* [7, 8]. Besides, Zenia *et al* subjected p-ZnTe crystals to electrochemical etching and observed the formation of needle-like structures exhibiting a blueshift of the excitonic

transition energies [9]. In this work, results on electrochemical pore etching in n-CdSe single crystals are presented. The luminescence of the samples was studied by CL in the scanning electron microscope (SEM) and by PL techniques. We show that optically homogeneous porous layers exhibit less luminescence intensity than bulk CdSe. At the same time considerable gain of luminescence was evidenced in some optically inhomogeneous areas of porous structures.

Wurtzite-phase n-CdSe single crystals were grown by chemical transport techniques using iodine as transport agent. Electrochemical etching was carried out in aqueous solution of HCl at room temperature under potentiostatic conditions as described elsewhere [10]. To reach uniform nucleation of pores, the samples were *in situ* illuminated by focusing the radiation of a 200 W Xe lamp on the CdSe surface (0.15 cm<sup>2</sup>) exposed to electrolyte. The morphology and chemical composition microanalysis of etched samples were studied using a TESCAN scanning electron microscope (SEM) equipped with an Oxford Instruments INCA Energy EDX system. PL was excited by the 514 nm line of an Ar<sup>+</sup> SpectraPhysics laser and analysed through a double spectrometer. The resolution was better than 0.5 meV. The