

DOCTORAL THESIS

Photoluminescence study of porous silicon

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Photoluminescence Study of Porous Silicon

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ABSTRACT

Porous silicon is fabricated using the electro-chemical anodization (ECA) system, and the photoluminescence properties of porous silicon is characterized by normal photoluminescence (NPL), grazing photoluminescence (GPL) and polarized photoluminescence (PPL). The luminescent properties of porous silicon in the visible range show the phenomenon of multiple peaks, photoselected absorption and linear polarization which is assigned to the size distribution due to nonuniform etching in layer-by-layers. Moreover, using the advantage of porous silicon having a wider bandgap, rare-earth doped porous silicon is attempted. We propose a new method of constant voltage electro-chemical doping (CVECD) based on the electro-chemical doping (ECD) process. After detail research is carried out on the doping parameters including constant voltage applied, electrolyte solution, and doping time, the optimum doping conditions for rare-earth doped porous silicon is obtained. Under the optimum doping, the enhancement and blue shift of photoluminescence in the visible range, and the atomic-like sharp peak in the infrared range are observed without annealing. Furthermore, the luminescent properties of rare-earth doped porous silicon is analyzed using normal photoluminescent measurement. A rare-earth related impurity energy level is derived from the thermalized dissociation. In addition, the results of the X-ray Photoelectron Spectroscopy (XPS) from rare-earth doped porous silicon provide further evidence for the existence of rare-earth in porous silicon after doping. Therefore, using the new doping method-CVECD, rare-earth elements are successfully injected into porous silicon.

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