

## 研究论文

### 二氧化硅基质包埋硅纳米晶的微观结构和发光性能

王乙潜<sup>1</sup>, 梁文双<sup>1</sup>, G.G.ROSS<sup>2</sup>

1. 青岛大学国家重点实验室培育基地~青岛市宁夏路308号 青岛 266071

2. INRS-EMT, 1650 boulevard Lionel-Boulet, Varennes, Canada J3X 1S2

摘要:

利用离子注入和后续高温退火的方法制备了包埋在二氧化硅(SiO<sub>2</sub>)基质中的硅纳米晶, 研究了不同离子注入浓度试样的微观结构和发光性能, 以及硅纳米晶的生长机理和发光机制. 结果表明: 较小的硅纳米晶(<5 nm)其生长机理符合Ostwald熟化机理, 较大的纳米晶(>10 nm)则是由多个小纳米晶粒通过孪晶组合或融合而成的; 离子注入浓度为 $8 \times 10^{16} \text{cm}^{-2}$ 的样品其发光强度是离子注入浓度为 $3 \times 10^{17} \text{cm}^{-2}$ 样品发光强度的5倍; 硅纳米晶内部的微观结构缺陷(如孪晶和层错)对其荧光强度有很大的影响.

关键词: 无机非金属材料 硅纳米晶 电子显微学 生长机理 荧光光谱

### Microstructure and optical properties of Si nanocrystals embedded in SiO<sub>2</sub> film

WANG Yiqian<sup>1</sup>, LIANG Wenshuang<sup>1</sup>, ROSS Guy<sup>2</sup>

1. The Cultivation Base for State Key Laboratory, Qingdao University, No.308, Ningxia Road, Qingdao, 266071

2. INRS-EMT, 1650 boulevard Lionel-Boulet, Varennes, Canada, J3X 1S2

Abstract:

Si nanocrystals have been fabricated in SiO<sub>2</sub> film using ion implantation followed by high-temperature annealing. The microstructure and optical properties of the samples with different Si<sup>+</sup> implantation doses were investigated, and the growth mechanism and light emission mechanism were explored. The experimental results indicated that for small Si nanocrystals (<5 nm), the growth mechanism conforms to Ostwald ripening; while for the big ones (>10 nm), the coalescence of small nanoparticles through twinning is dominant. The photoluminescence (PL) investigation showed that the PL spectrum intensity from the sample with an implantation dose of  $3 \times 10^{17} / \text{cm}^2$  dropped by a factor of 5 compared with that from the sample with an implantation dose of  $8 \times 10^{16} / \text{cm}^2$ . The correlation between microstructure and PL indicated that the microstructural defects, such as twinning and stacking faults inside the Si nanocrystals have a great influence on the PL intensity.

Keywords: inorganic non-metallic materials Si nanocrystals transmission electron microscopy growth mechanism photoluminescence

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通讯作者: 王乙潜

作者简介:

作者Email: yqwang1013@yahoo.com.cn

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