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激光与光电子技术应用

连续氩氪离子激光晶化非晶硅薄膜的研究

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摘要:

为了研究连续激光晶化非晶硅薄膜中激光功率密度对晶化效果的影响,利用磁控溅射法制备非晶硅薄膜,采用连续氩氪混合离子激光器对薄膜进行退火晶化,用显微喇曼光谱测试技术和场发射扫描电子显微镜研究了薄膜在5ms固定时间下不同激光功率密度对晶化效果的影响,并对比了普通玻璃片和石英玻璃两种衬底上薄膜晶化过程的差异。结果表明,在一定激光功率密度范围内(0kW/cm^2~27.1kW/cm^2),当激光功率密度大于15.1kW/cm^2时,普通玻璃衬底沉积的非晶硅薄膜开始实现晶化;随着激光功率密度的增大,晶化效果先逐渐变好,之后变差;激光功率密度增大到24.9kW/cm^2时,薄膜表面呈现大面积散落的苹果状多晶硅颗粒,晶粒截面尺寸高达478nm ;激光功率密度存在一个中间值,使得晶化效果达到最佳;石英衬底上沉积的非晶硅薄膜则呈现与前者不同的结晶生长过程,当激光功率密度为19.7kW/cm^2时,薄膜表面呈现大晶粒尺寸的球形多晶硅颗粒,并且晶粒尺寸随着激光功率密度的增大而增大,在27.1kW/cm^2处晶粒尺寸达到最大5.38μm。研究结果对用连续激光晶化法制备多晶硅薄膜的研究具有积极意义。

关键词: 薄膜 多晶硅 连续激光晶化 激光功率密度 衬底

Study about continuous Ar^+Kr^+ laser crystallization of amorphous silicon thin film

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Abstract:

In order to study the influence of laser power density on crystallization effect in continuous laser crystallization of amorphous silicon thin film, amorphous silicon thin films were prepared by means of magnetron sputtering and then crystallized by continuous Ar^+Kr^+laser. Crystallization effect was studied by means of micro-Raman spectroscopic measurement and field emission scanning electron microscope under the fixed time 5ms and different laser power density. The difference of crystal growth process on two different substrates-common glass substrate and quartz substrate was compared.It was shown that within the limit of 27.1kW/cm^2 the amorphous Si films were able to be crystallized at laser power densities above 15.1kW/cm^2 on common glass substrate, crystallization effect became better first and then worse with the increase of laser power density, large area of scattered apple shape polysilicon particles of crystal size around 478nm can be obtained at 24.9kW/cm^2. An intermediate laser power density value exists to make the crystallization effect best. Films deposited on quartz substrate present a different crystallization growth process, large spherical polysilicon particles emerged as the energy density reaches to 19.7kW/cm^2,with the increase of energy density, the particle size got larger and the maximum size 5.38μm was obtained at 27.1kW/cm^2. These results play a positive role in studying preparing poly-Si thin film by means of continuous laser crystallizing.

Keywords: thin films polycrystalline silicon continuous laser crystallization laser power density substrate

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