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论文

ECR-CVD制备氟化非晶碳低*k*介质薄膜

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摘要 采用电子回旋共振等离子体化学气相沉积(ECR-CVD)方法，以C4F8和CH4为源气体在不同气体流量比*R*(*R*=［CH_4］/{［CH_4］+［C_4F_8］})条件下成功地沉积了氟化非晶碳(a-C:F)低介电常数（低*k*）材料。采用X光电子能谱和椭圆光谱方法分析了a-C:F薄膜的化学组分和光学性质。沉积的a-C:F薄膜介电常数约为2.1～2.4，热稳定性优于350℃。随着气体流量比的增大，沉积a-C:F薄膜中的碳含量增大，CF、CF2、CF3含量减少，C-C交链成分增加，从而使得π-π*吸收增强，并引起薄膜光学带隙下降。氮气气氛下350℃温度退火后应力释放引起a-C:F薄膜厚度变化，变化量小于4%。450℃温度退火后，由于热分解作用薄膜厚度变化量在30%左右。

关键词 氟化非晶碳 ECR-CVD 光电子能谱 椭圆光谱

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Low-dielectric-constant fluorinated amorphous carbon films prepared by ECR-CVD

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Abstract Low-dielectric-constant (low-k) fluorinated amorphous carbon (a-C:F) films were prepared by electron cyclotron resonance chemical vapor deposition (ECR-CVD) method with varying the gas flow ratio *R*(*R*=［CH_4］/{［CH_4］+［C_4F_8］}). Chemical compositions and optical properties were investigated by X-ray photoelectron spectroscopy (XPS) and spectral ellipsometry (SE), respectively. a-C:F films with dielectric constant of 2.1~2.4 and thermal stability higher than 350℃ were obtained. The CF, CF_2 and CF_3 bonds decrease and the C-C bonds increase with increasing gas flow ratio, which leads to enhancement of π-π* absorption and reduction of optical gap. Film thickness change is less than 4% due to stress release between the a-C:F films and the silicon substrates after 350℃ annealing. The film thickness change is around 30% mainly due to thermal decomposition of volatile fluorocarbon species after 450℃ heat treatment.

Key words fluorinated amorphous carbon ECR-CVD XPS spectral ellipsometry

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