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核技术应用

直流磁控溅射沉积含He钛膜的研究

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摘要

研究了用He/Ar混合溅射气体的直流磁控溅射制备钛膜中，He的掺入现象.分析结果表明，大量的He原子（He/Ti原子比高达56%）被均匀地引入到Ti膜中，其He含量可由混合溅射气体的He分量精确控制.通过调节溅射参数，可实现样品中He的低损伤引入.研究还发现，溅射沉积的含氦Ti膜具有较高的He成泡剂量和高的固He能力，这可能是溅射沉积形成了纳米晶Ti膜所致.纳米晶Ti膜较粗晶材料具有很高浓度的He捕陷中心，使He泡密度增大而泡尺寸减小.随He引入量的增加，Ti膜的晶粒尺寸减小，He引起的晶体点阵参数和X射线衍射峰宽度增大，晶体的无序程度增加.

Helium trapping in the Ti films deposited by DC magnetron sputtering with a He/Ar mixture was studied. He atoms with a surprisingly high concentration (He/Ti atomic ratio is as high as 56%)incorporate evenly in deposited film. The trapped amount of He can be controlled by the helium partial amount. The introduction of the helium with no extra damage(or very low damage) can be realized by choosing suitable deposition conditions. It was also found that because of the formation of nanophase Ti film a relative high He flux for bubble formation is needed and the amount of the retain He in sputtering Ti films is much higher than that in the coarse grain Ti films. The nanophase Ti film can accommodate larger concentration of trapped sites to He, which results in a high density and small size of the He bubbles. With the increasing He irradiation flux, the grain size of Ti film decreases and the lattice spacing and width of the X ray diffraction peak increase due to the He introduction, and the film tends to amorphous phase.

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