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反应堆工程

Ti及Ti合金中氦泡形貌的透射电镜研究

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摘要 利用磁控溅射方法在Ti、TiZr和TiMo合金膜中引入氦并进行热处理后，用透射电镜观察膜材中的氦泡。所观察到的氦泡可为多面体形或球体形，或多数为球形化的多面体形。在800 ℃热处理后的Ti和TiZr合金中均观察到规则的六边形和八边形氦泡，对应基体材料单晶平衡外形多面体的投影。720 ℃热处理40 min后，TiZr合金膜中的氦泡比同样温度热处理130 min后的接近球形。在600~650 ℃热处理30~60 min后，合金中的氦泡比纯Ti中的氦泡更接近球形，生长受到的阻碍更大。除热处理温度、时间和合金成分外，晶界和其他氦泡也会影响氦泡形貌。在三叉晶界处的氦泡比晶界处的氦泡圆滑。氦泡在与其他氦泡邻近的部分会变得圆滑，促使自身向对方运动，促进氦泡的合并、长大。

关键词 氦泡 磁控溅射 Ti TiZr合金 TiMo合金 晶界 球形化多面体

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Investigation on Helium Bubbles Shape in Ti and Ti Alloy by Transmission Electron Microscopy

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Abstract Helium was introduced into Ti,TiZr alloy and TiMo alloy films during magnetron sputtering. After annealing at several conditions, helium bubbles were found in the films via observations by a JEOL transmission electron microscopy. The shapes of bubbles are polyhedrons, spheres and are most spherized polyhedrons. In the Ti film and the TiZr alloy film annealed at 800 ℃, there are a lot of regular hexahedron or octahedron bubbles, which are the same as the projections of equilibrium shape of their matrix crystal. With annealing temperature of 720 ℃, the bubbles in TiZr alloy annealed for 40 min are more round than those annealed for 130 min. When annealing for 30-60 min at 600-650 ℃, the bubbles in alloy are more round than those in pure Ti, and are prohibited more from growth. Besides annealing temperature, annealing time and alloy composition, grain boundaries and other bubbles also affect the bubble shape. Bubbles on triple boundary junctions are more round than those on normal boundaries. And the parts of two neighbor bubbles nearest each other are usually round, which leads move towards the other and finally enhance the bubble growth.

Key words helium bubbles magnetron sputtering Ti TiZr alloy TiMo alloy grain boundary spherized polyhedron

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