复合金属薄膜层对金丝键合性能的影响

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摘　要: 采用磁控溅射在 96 氧化铝陶瓷基板上制备了 TiW/Ni/Au 和 Ti/Ni/Au 结构的键合薄膜层,通过调节溅射时长对金层厚度进行控制,模拟光通讯模块中金丝键合工艺并对薄膜进行了键合性能评估。结果表明,Ti/Ni/Au 结构具有更加良好的键合效果。键合推拉力的大小随着金层厚度的增加而变化。在≤2μm 厚度范围内,拉力随金层厚度的增加出现波动,保持在 7.5gf ± 3%(1gf=9.81 × 10^{-3}N);推力则随着膜厚的增加先增大后减小,继而保持波动,当厚度为 930nm 时,推力最大,为 78.68gf,厚度大于 1μm 后,拉力保持在 72.03gf ± 1.8%。数据统计分析结果显示,推拉力的离散程度均随着金层厚度的增加出现先降低后升高的趋势。金丝键合性能与基体上复合金属薄膜层的结构、厚度均存在密切关系,金层厚度过小不易于金丝紧密结合,而厚度增加到一定程度后则降低了与现有键合工艺的匹配。由此可见,在小于 2μm 范围内通过减小金层厚度可以在保证键合质量的同时有效节约成本。

关　键　词: 键合薄膜;金丝键合;磁控溅射;光通讯

中图分类号: O484.1;TB43　　**文献标识码:** A　　**文章编号:** 1002-0322(2021)06-0043-05

doi:10.13385/j.cnki.vacuum.2021.06.08

Effect of Metallic Multilayer Films on Gold Wire Bonding Properties

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Abstract: Multilayer films with different structures (TiW/Ni/Au & Ti/Ni/Au) and thicknesses were deposited on ceramic substrates ($96Al_2O_3$) by magnetron sputtering. The gold film thickness was controlled by adjusting the sputtering time. The multilayer films were used to simulate the gold wire bonding in optical communication modules, and their bonding performance were evaluated. The results show that Ti/Ni/Au structure has better bonded effect than that of the TiW/Ni/Au. In the experiment of gold wire bonding with different thickness, the magnitude of pull and thrust strength changes with the increase of gold layer thickness. The pull strength is kept in 7.5gf±3% when the thickness is less than 2μm(1gf=9.81× 10^{-3}N). When the thickness of the gold film is 930 nm, the thrust strength is the maximum (78.68gf), and it decreases with the increase of the thickness. Then, the thrust strength is kept in 72.03gf±1.8%. The results of statistical analysis show that the dispersion degree of push and thrust strength decreases first and then increases with the increase of thickness. Therefore, there is a certain relationship between the bonding properties and the structure and thickness of the bonding film layer. The results show that the thickness is too thin to bond with the gold wire, while the thicker film reduces the matching with the bonding process. This indicates that the bonding quality can be controlled and the cost can be saved by reducing the thickness of the gold layer.

Key words: multilayer films; gold wire bonding; magnetron sputtering; optical-communication

引线键合工艺作为微电子封装中一级互联的主流工艺,相较于载带自动焊接和倒装芯片焊接具有操作简单、成本低廉和封装形式多样化等优点,在微电子封端技术中使用率最高[1-2]。其中,纯金丝比其他金属材料具有更大的电导率、更好的耐腐蚀性和韧性而被广泛使用。随着微电子信

收稿日期: 2020-10-20

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