

射频磁控溅射对 PET 基材制备铝薄膜的性能影响

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摘 要: 针对传统制铝技术, 为提高膜层结合力、阻隔性, 采用射频磁控溅射镀铝工艺, 制备纯铝高阻隔性膜层, 在 PET 塑料薄膜表面沉积纯铝的实验。通过对射频电源功率和溅射气压等参数的改变, 探究射频功率、溅射气压对薄膜结合力、阻隔性的影响。结果表明: 薄膜沉积过程中的射频功率和溅射气压对磁控溅射铝薄膜性能影响较大, 在一定的溅射压力下, 膜层的结合力随射频功率的增大而逐渐增大, 膜层的阻隔性随射频功率的增大, 先提高后降低, 射频功率为 85W 时, 氧气透过率最小为 $1.11\text{cm}^3/(\text{m}^2 \cdot \text{day} \cdot \text{atm})$; 在射频功率相同的情况下, 结合力随着溅射气压的增大, 先增大后降低, 膜层的阻隔性随着溅射气压的增大而逐渐降低, 溅射气压为 0.5Pa 时, 结合力最高为 1.68N/mm。较传统铝膜结合力提高 2 倍, 阻隔性提高 5 倍。

关 键 词: 铝; 高阻隔薄膜; 射频磁控溅射; 射频功率; 溅射气压

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Effect of RF Power and Sputtering Pressure on Al Film Sputtered on Polythylene Terephthalate Substrates

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Abstract: Aiming at the traditional aluminum production technology, in order to improve the adhesion and barrier property of the film, the RF magnetron sputtering aluminum plating process was adopted to prepare the high barrier layer of pure aluminum by depositing pure aluminum on the surface of PET plastic film. The influences of RF power and sputtering air pressure on film adhesion and barrier property were investigated by changing the parameters of RF power and sputtering air pressure. The results show that the RF power and sputtering pressure in the deposition process have a great influence on the performance of the magnetron sputtered Al film. Under a certain sputtering pressure, the bonding strength of the film layer gradually increases with the increase of the RF power, and the barrier property of the film layer increases with the increase of the RF power, and then decreases. When the RF power is 85W, the minimum oxygen transmittance is $1.11\text{cm}^3/(\text{m}^2 \cdot \text{day} \cdot \text{atm})$. Under the condition of the same RF power, the binding force increases first and then decreases with the increase of sputtering air pressure, and the barrier property of the film decreases gradually with the increase of sputtering air pressure. When the sputtering pressure was 0.5Pa, the highest binding force was 1.68N/mm. Compared with the traditional aluminum film, the binding force is increased by 2 times and the barrier property is increased by 5 times.

Key words: Al; high barrier materials; RF magnetron sputtering; RF power; sputtering pressure

近几年,随着经济的发展及人们生活水平的提高,人们对食品包装行业的安全也越来越重视,高阻隔膜材料因阻隔性能优异,且成本低廉、耐腐蚀、加工方便、印刷适应性强、机械性能好、无毒等优点,广泛应用于食品、药品、精密电子器

件、酒类等产品包装^[1-3]。常见的高阻隔材料主要有以下几种:聚偏氯乙烯(PVDC)、乙烯-乙烯醇共聚物(EVOH)、聚酰胺(PA)、聚酯类(PET、PEN)^[4-6]。但由于聚合物本身的结构特性决定了其对小分子气体的阻隔性较差,无法满足日常食

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