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微纳技术与精密机械

电极表面粗糙度对检测电容的影响

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摘要： 平行板电容是大多数MEMS传感器件的核心检测结构。考虑随着检测电极间距的减小，电极表面粗糙度会对其空间电场分布产生影响，本文研究了电极表面粗糙度对检测电容性能的影响。建立了单粗糙电极的平行板电容器模型，并采用有限元法分析了表面粗糙度和边缘效应对静电场分布的影响；针对粗糙表面增大了电极存储电荷的能力，对粗糙表面的平行板电容器计算公式进行了修正。采用原子力显微镜对不同粗糙度的样本进行了表征，实验和仿真结果表明：减小两电极之间的距离，增大检测电极的表面粗糙度，可以显著增大检测电容。当检测电极的粗糙度从0.063 nm增加到60 nm时，平行板电容器电容值增大了9.0%。结论显示，增大MEMS电容器两电极的表面粗糙度，可以有效地增大MEMS器件的检测灵敏度。

关键词： 检测电容 表面粗糙度 电极 微机电系统

Effect of the surface roughness on detecting capacitance

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Abstract: Parallel plate capacitor is a core mechanism in a Micro-mechanical-electrical (MEMS) sensing device. As the surface roughness of an electrode has obviously impact on the space electric field when the distance between the electrodes is shortened in the capacitance detection, this paper explores the effect of the surface roughness of electrode on the performance of the parallel plate capacitor. A parallel plate capacitor model with a single roughness electrode was established, and then the finite element method was used to study the effect of the surface roughness on the detecting capacitance. Based on increasing rough surface to enhance the memory electric charge capability, the formula for parallel plate capacitor with rough surface was corrcted. Finally, the Atomic Force Microscopy(AFM) was used to describe the samples with different surface roughnesses. Experiments and simulation results indicate that the surface roughness has a obviously effect on the detecting capacitance. Increasing the surface roughness of an electrode and decreasing the distance between the electrodes can improve the detecting capacitance greatly. When the surface roughness of an electrode increases from 0.063 nm to 60 nm, the detecting capacitance value grows by 9.0 percent. The result shows that increasing the surface roughnesses of electrodes can improve the sensitivity of MEMS devices.

Keywords: Detecting capacitance surface roughness electrode Micro-Electro-Mechanical Systems (MEMS)

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