

MEMS宽带电化学地震检波器

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MEMS based broadband electrochemical seismometer

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摘要 图/表 参考文献 相关文章 (8)

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摘要 针对深部油气勘探的需要,研制了基于微机电系统(MEMS)的宽带电化学地震检波器。仿真分析了影响该检波器频带的结构参数,并对其MEMS实现及封装方法进行了研究。利用有限元软件分析绝缘层厚度和阴极孔径对检波器幅频特性的影响,得到了优化的几何参数。基于仿真结果,利用MEMS工艺加工硅基的Pt电极和Su-8的绝缘层,然后用物理紧固的方法进行器件封装。最后,分别在水平振动台和基岩上进行了检波器的性能测试和微震监测实验。实验结果表明:无需进行频率补偿,由20 μm孔径阴极和200 μm厚绝缘层封装的器件的频带可扩展到3~90 Hz,低频扩展到60 S的补偿幅度小于30 dB,检波器的动态范围不小于130 dB。实验显示:这种改进的检波器可以作为宽带地震检波器用于深部或海底的油气勘探。

关键词 : 微机电系统(MEMS), 电化学地震检波器, 宽频带, Su-8绝缘层

Abstract : On the basis of Micro-electro-mechanical System(MEMS), a broadband electrochemical seismometer was developed. The structure parameters related to the seismometer were analyzed and a developing scheme based on MEMS technology was presented to extend the frequency band of the seismometer to a wider range. The effects of the lengths of insulating spacers and the pore widths in cathodes on the seismometer property were discussed by numerical simulation and the optimized structure parameters were obtained. Then, according to simulation results, the Su-8 series photoresist and a silicon wafer were applied to fabrication of spacers and electrodes with optimized sizes. These devices were packaged via a physical fastening method to avoid the leakage of electrolyte. Finally, the device characteristics were measured through frequency response test on a horizontal vibration platform and a micro seismic monitoring experiment was performed on the bedrock. Test results without frequency compensation demonstrate that the frequency band of the device packaged with spacers with thickness of 200 μm and cathodes with wide pores of 20 μm has reached 3-90 Hz, the fade degree at 60 S is less than 30 dB, and the seismometer's dynamic range is no less than 130 dB. This improved seismometer may function as a detecting device covering a wide frequency range in the marine oil exploration.

Key words : Micro-electro-mechanical System(MEMS) electrochemical seismometer broadband Su-8 insulating spacer

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