

Development of Amplitude-Controlled Parallel-Fatigue-Test System for Micro-Electromechanical Resonators

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Fatigue in silicon has become an important issue for ensuring the reliability of micro-mechanical systems. However, the fatigue characteristics of micrometer-scale silicon specimens have not yet been clearly understood because of the difficulties in fatigue testing. Here, the authors describe the design, fabrication, measurement, and tuning of a fatigue test system developed for deflection-amplitude-controlled parallel testing using self-oscillation. The amplitude-controlled oscillation was fundamental for performing the fatigue test reliably and the tuning of the time constant was crucial to obtaining stable oscillation considering the mechanical response of the test device. As the electric system was integrated on a small circuit board and had a simple interface with a control computer, it was easy to fabricate a scaled-up, parallel-test system. Up to fourfold parallel testing was actually performed. A problem with the parallel testing system concerning signal interference was reported. Lifetime measurement and the acquisition of a deflection signal at fracture were successfully performed using the test system.

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