Chip-scale Optical Clock Based on Modulation Transfer Spectroscopy

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In order to realize the chip optical clock with high stability and low volume power consumption, this paper propose a scheme for realizing a chip-scale optical clock based on modulation transfer spectroscopy[1]. The on-chip optical clock uses on-chip laser, lithium niobate thin film waveguides and MEMS cells. By using modulation transfer spectrum with high signal-to-noise ratio and full bandwidth high speed servo feedback, the laser frequency can be stabilized at the hyperfine transition of rubidium atom. In addition, the MEMS cells is used to build a compact optical clock based on the modulation transfer spectrum principle, which verifies the feasibility of the chip optical clock. At present, the compact optical clock frequency Allan deviation is 5E-13@1s.

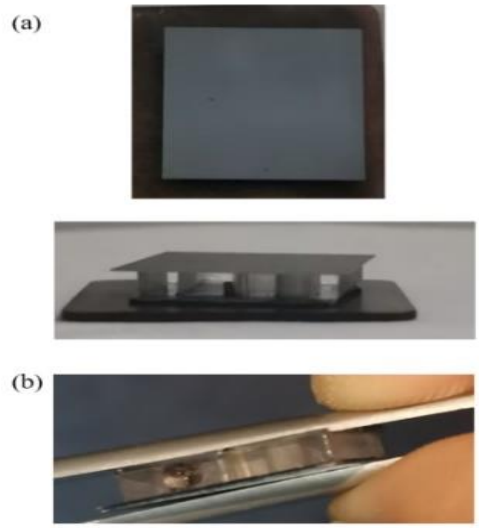

Fig. 1: (a) The MEMS cells before activation; (b)The MEMS cell after activation.

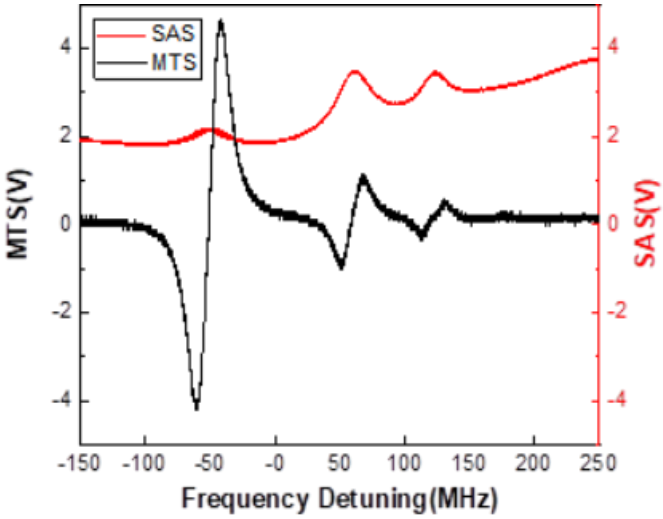

Fig. 2: Saturation absorption spectroscopy (red-solid line) and corresponding modulation transfer spectroscopy (black-solid line) of the compact optical clock transfer line.

[1] Shang H, Zhang T , Miao J ,et al. Laser with 10-13 short-term instability for compact optically pumped cesium beam atomic clock[J]. Optics Express, 2020, 28(5):6868-6880.