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Micromachined piconewton force sensor for biophysics investigations[1] STEVEN KOCH, GAYLE THAYER, ALEX CORWIN, GEORGE BACHAND, MAARTEN DE BOER, Sandia National Laboratories — We describe a polysilicon surface-micromachined force sensor that is able to measure forces as small a few pN in both air and water. The simple device consists of compliant springs with force constants as low as 0.3 mN/m and Moire patterns for nanometer-scale optical displacement measurement. First, we measured the force field produced by an electromagnet on individual 2.8 micron magnetic beads glued to the force sensor. Forces matched predictions from finite element magnetic modeling and provided a calibration for future biophysical applications of the magnet. By repeating with several different beads, we measured a 9 percent standard deviation in saturation magnetization. We also demonstrated that the force sensor was fully functional when immersed in aqueous buffer and when performing the kinesin inverted motility assay on the sensor surfaces. These results show the force sensors can be useful for calibrating magnetic forces on magnetic beads and also for direct measurement of biophysical forces on-chip.

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