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Measurements of the Casimir interaction between a sphere and a rectangular corrugated plate YILIANG BAO, H. B. CHAN, University of Florida — We present measurements of the Casimir force gradient between a gold-coated sphere and a highly doped silicon plate with an array of nanoscale, high-aspect-ratio trenches. The Casimir force arises from quantum fluctuation of electromagnetic fields in vacuum and is strongly dependent on the boundary condition. While the majority of the precise measurements have been performed on the simple arrangement of plate-sphere or two parallel plates, few experiments have been done in geometries with interactions that deviate significantly form the pair-wise summation of two-body potentials. We choose one of the interacting surfaces to be an array of trenches with widths ranging from 200 nm to 500 nm and depth of 1um. Theoretical analysis predict that for perfectly conducting surfaces with such geometry, the Casimir force differs by up to 70 % from pairwise summation at separation of 0.4 um. In our experiment, the force gradient is measured by the frequency shifts caused by Casimir force in the response of a periodically driven micromachined torsional oscillator, yielding a highly sensitive measurement of the force gradient for separations between 80nm and 500nm.

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