Casimir force and levitation phenomena in plane-parallel systems made of dielectric materials

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The Casimir force (*Fc*), originated from vacuum fluctuations, is a very intense force between bodies separated by nano- and micro- scale distances. Typically, it is an attractive force, however repulsive *Fc* is interesting for preventing stiction and adhesion phenomena in NEMS and MEMS. In addition, the nature and intensity of *Fc* depend on the optical properties of the involved materials, among other parameters. In this regard, paying attention to their dielectric function, we look for combinations of realistic materials that give rise repulsive *Fc*.

In particular, we calculate *Fc* in planar configurations in which a self-standing slab immersed in a fluid faces a substrate, thus the fluid is mediating the Casimir interaction. Repulsive *Fc* in these systems may counteract the effect of the gravity and buoyancy forces (F_g and F_B) and give rise to levitation phenomena.

Fc is calculated using Lifshitz's theory [1] and dielectric functions of realistic dielectric materials are considered [2].

We find that thin films made of Teflon, silica and polystyrene immersed in glycerol stand at a certain equilibrium separation distance (d_{eq}) above a silicon substrate due to the balance of the forces. We also study the effect of temperature, layer thickness and number of layers on *Fc* and d_{eq} [3, 4].

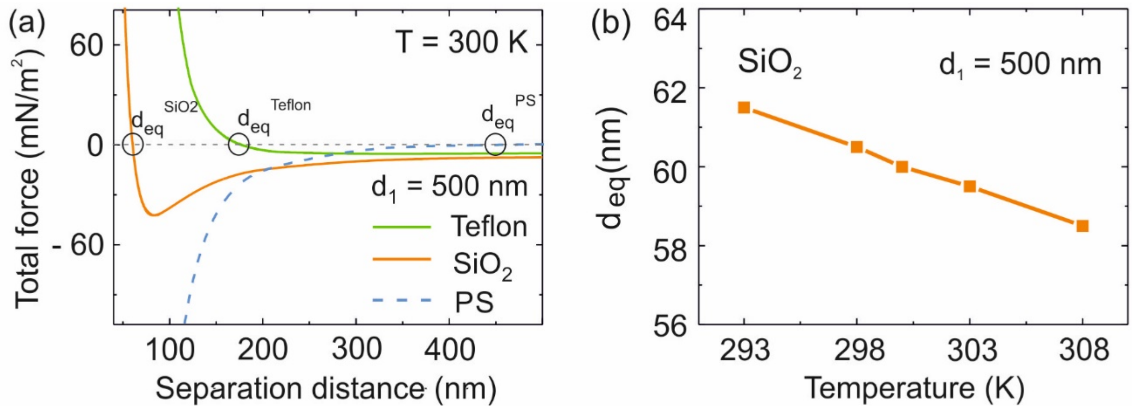

Fig. 1 (a) Total force (i.e. $\overrightarrow{F_C} + \overrightarrow{F_B} + \overrightarrow{F_g}$) as a function of the separation distance for a film of 500 nm of thickness made of three materials: Teflon (green), SiO_2 (orange) and PS (blue). The fluid and the substrate are considered to be glycerol and silicon, respectively. d_{eq} is the separation distance at which the total force is zero. (b) Equilibrium distance as a function of temperature attained for a silica thin film of 500 nm thickness.

[1] Lifshitz, E. M. *Sov. Phys. JETP* **1956**, 2, 73.
[2] van Zwol, P. J. et al. *Phys. Rev. A.* **2010,** 81, 062502.
[3] Esteso, V. et al. *J. Phys. Chem. C* **2015**, 119, 5663-5670.
[4] Esteso, V. et al. J. *Appl. Phys* **2016**, 119, 144301.