Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

A   First-Principles Method of Determining van der Waals Forces in Dissipative Media[1] YI ZHENG, ARVIND NARAYANASWAMY, Department of Mechanical Engineering, Columbia University — Lifshitz theory of van der Waals (vdW) force and energy between two planar objects is strictly valid when the medium separating two planar objects is vacuum. Generalization of Lifshitz theory to the case when intervening medium is a dissipative material, as opposed to vacuum, is a surprisingly difficult undertaking because there is no expression for the electromagnetic stress tensor in dissipative materials. Here, we derive the expression for vdW energy and pressure in planar multilayered dissipative media by computing the work done in assembling the multilayered structure from its constituent thin films. In doing so, we avoid any calculations of the Maxwell stress tensor in any medium but vacuum. Even though this work has proven to be a corroboration of Dzyaloshinskii, Lifshitz, and Pitaevskii, it has thrown new light on our understanding of vdW forces and suggests that it should be possible to achieve the similar result for objects with arbitrary shapes.

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Date submitted: 11 Nov 2011   Electronic form version 1.4