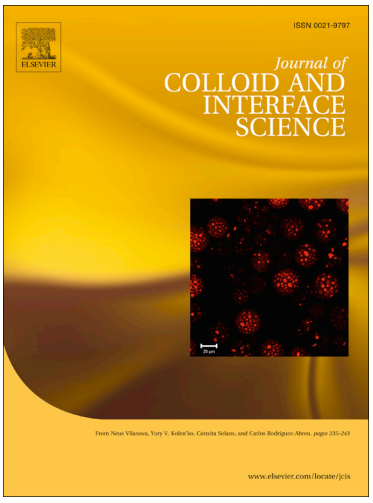

Lifshitz analysis of dispersion forces based on quantitative Reflection Electron Energy Loss Spectroscopy

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Lifshitz analysis of dispersion forces based on quantitative Reflection Electron Energy Loss Spectroscopy

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Additional Supporting Information may be found in the online version of this article.

Keywords: Lifshitz; Hamaker constant; REELS; QUEELS; Energy Loss; Retardation

Abstract

Hypothesis

The energy loss experienced by an electron while moving through a solid is determined by the optical properties of the surrounding. Hence, quantitative Reflection Electron Energy Loss Spectroscopy (REELS) should allow the determination of optical data required for the calculation of Hamaker coefficients using Lifshitz theory. This approach might improve the accuracy of calculated Hamaker coefficients and should also enable to harness the unique capabilities of REELS to analyse nanostructured surfaces and thin-films with great spatial resolution and surface sensitivity.

Experiments

REELS spectra of a survey of insulating polymers and of metal-like $Ti_{0.23}Al_{0.32}N_{0.44}$ (TiAlN) were measured, the complex dielectric functions determined and the corresponding Hamaker coefficients across vacuum and water calculated. The sensitivity of the quantification procedure towards typical systematic errors was investigated. For polystyrene the results were comparatively analysed using vacuum ultraviolet spectroscopy (VUV).

Findings

The accuracy especially of the non-retarded vacuum Hamaker constants of the polymers was increased when compared to VUV reflectance spectroscopy due to the higher spectral range of REELS. Furthermore, a new correction procedure for the intricate case of unresolved inelastic losses in the REELS spectrum, such as encountered in the case of TiAlN, could be developed using spectroscopic ellipsometry as a complementary mean.