Dielectric function for a semi-infinite metal

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Investigating of the interacting electronic subsystem of metal is one of the central problems of solid state physics. It is caused by that the electronic subsystem plays a main role in formation of the basic characteristics of a metal crystal, such as its structure, binding energy, phonon spectrum, electromagnetic properties. Research of interacting electronic subsystem in itself is difficult, and in case of the semi-infinite metal considered by us becomes more difficult because the electronic subsystem is very nonuniform near a metal surface.

In non-bounded metal the screening properties of the interacting electronic subsystem, and also dispersion of plasmon oscillations are defined by dielectric function $\varepsilon(\mathbf{q},\omega)$, which is a scalar function of a three-dimensional wave vector $\mathbf{q}$ and frequency ω. In contrast to non-bounded metal the dielectric function, owing to presence of a flat surface of metal, is not a scalar function, and is a matrix function $\varepsilon_{k_1,k_2}(\mathbf{q},\omega)$, here $\mathbf{q}$ is two-dimensional wave vector responsible for expansion of Fourier in a plane parallel to the surface, k_1 and k_2 are responsible for expansion of Fourier perpendicularly to the surface. We have proposed an approach to calculation of dielectric function taking into account correlation effects in approach which is similar to local field corrections in the theory of homogeneous electronic gas. Efficiency of this approach is illustrated by calculations of static ($\omega = 0$) dielectric function and effective potential of interelectronic interaction. It is shown, that the offered approach correctly considers the image forces.