Anomalous Skin Effect in a Drude-type Model Incorporating the Spatial Dispersion for Systems with Conductivity of Metal

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Simple and clever semiclassical model of the Drude-model type has been complemented recently by incorporation of the dependence on spatial variables[1]. The model is rather encouraging in interpretation of novel effects induced by the spatial dispersion in the high frequency response of high$-T_c$ and ordinary superconductors. Anomalous skin effect, which is characteristic manifestation of the spatial dispersion in the microwave response of cooled conductors, is explored here as a trial problem to estimate the potentialities of the considered semiclassical model. A complex value of the surface impedance $Z = R+iX$ with the phase of $\pi/3$ and with the dependence of the module on the microwave frequency $|Z| \sim \omega^{2/3}$ characteristic for an extremely anomalous regime is interpreted using the dispersion law of additional waves for modelling media (one-dimensional conductivity) obtained in the model[1]. The model describes these main features and highlights novel aspects of the phenomenon indicating the manifestation: (i) of resonance effects (the true real value and vanishing of the imaginary part of the complex factor, which characterises the transmittivity of the volume density of the electromagnetic-field momentum through the boundary surface of the conductor) of the spatial-resonance type resulting in the $\pi/3$ value of the phase, and (ii) of the excitation of additional waves in the metal, which explains the dependence $|Z| \sim \omega^{2/3}$.

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