Fig. 2:

$\epsilon_2(\omega)+\mathrm{i}10^{-1}$ Si from Aspnes

$$L_0=\sqrt{\hbar\pi ac/eV_0},$$

$$q_0=m_e v\gamma/\hbar,\ \beta=v/c.$$

$$\frac{d\Gamma}{dy}(\mathbf{r},\omega)=\frac{2e^2}{\pi\hbar v^2}\int_0^\infty \frac{\mathrm{d}k_x}{k_\parallel^2}\mathrm{Re}\left\{k_{z1}\mathrm{e}^{2\mathrm{i}k_{z1}z_\mathrm{e}(\mathbf{r})}\left[\left(\frac{k_x v}{k_{z1}c}\right)^2 r^\mathrm{s}_{123}(k_\parallel)-\frac{1}{\epsilon_1}r^\mathrm{p}_{123}(k_\parallel)\right]\right\},$$ #paper149 Eq. (25)

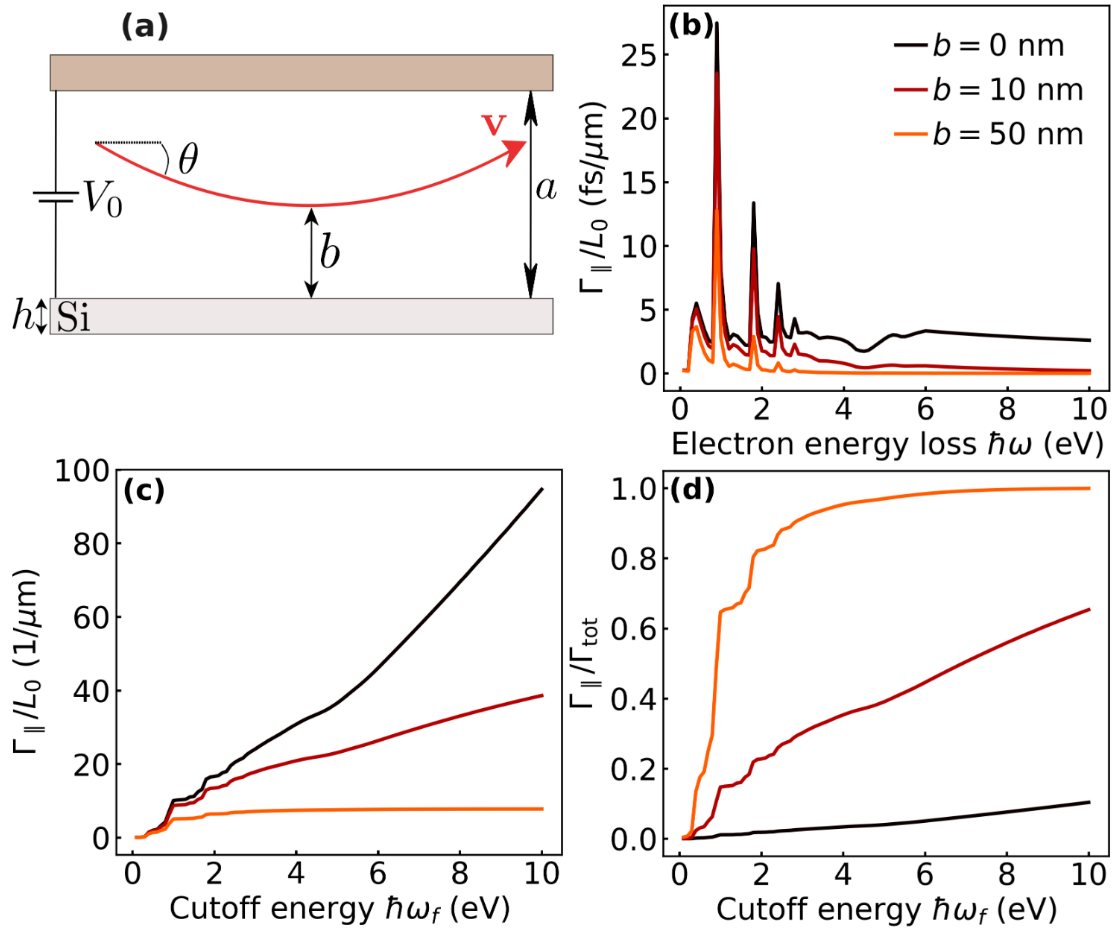
$$\Gamma(\omega)=\frac{2e^2}{\pi\hbar v^2}\int_0^\infty \frac{\mathrm{d}k_x}{k_\parallel^2}\mathrm{Re}\left\{\underbrace{\int_{-\infty}^{\infty}\mathrm{d}y\,\mathrm{e}^{2\mathrm{i}k_{z1}z_\mathrm{e}(y)}}_{L^\mathrm{eff}(k_\parallel)}\,k_{z1}\left[\left(\frac{k_x v}{k_{z1}c}\right)^2 r^\mathrm{s}_{123}(k_\parallel)-\frac{1}{\epsilon_1}r^\mathrm{p}_{123}(k_\parallel)\right]\right\},$$

$$L^\mathrm{eff}(k_\parallel)\approx L_0\mathrm{e}^{2\mathrm{i}k_{z1}b}\sqrt{\frac{\beta q_0}{k_\parallel}},$$

(c)

$$\int_0^{\omega_\mathrm{f}}\mathrm{d}\omega\frac{\Gamma(\omega)}{L_0}$$

integration over frequency




(d)

$$\frac{\int_0^{\omega_\mathrm{f}}\mathrm{d}\omega\Gamma(\omega)}{\int_0^{\infty}\mathrm{d}\omega\Gamma(\omega)}$$

normalization over all frequencies

FIG. 4. **Electron coupling to a waveguide mode**. **(a)** Schematic representation of an electron beam moving with velocity $\mathbf{v}$ towards an infinite Si surface with a thickness $h$ embedded in vacuum. A gate is placed at $z=a$ from the waveguide, and the voltage difference between them is $V_0$. The electron is repelled by the $V_0$ reaching a minimum distance to the waveguide of $b$. The electron excites the waveguide modes supported by the surface. **(b)** Total EEL probability (i.e., integrated over wave vector as defined in Eq. (7)) normalized to $L_0=\sqrt{\hbar\pi ac/eV_0}$, as a function of the electron energy loss $\hbar\omega$, for different values of the electron-surface minimum distance $b$. **(c)** Same as (b) but integrated over the electron frequency loss from 0 to the cutoff energy $\omega_f$, as a function of the cutoff energy, for the same values of $b$. **(d)** Same as (c) normalized to the total EEL, $\Gamma_\mathrm{tot}$, defined as the $\Gamma_\parallel$ integrated over all the electron frequencies loss, for the same values of $b$ as in (b). In all panels, the thickness of the surface is $h=0.2$ $\mu$m and the energy of the electron parallel to the plane is $E_{\mathrm{e},y}=100$ keV.