SILICON ABSORPTION ENHANCEMENT FOR SOLAR ENERGY CONVERTERS

Narek Margaryan

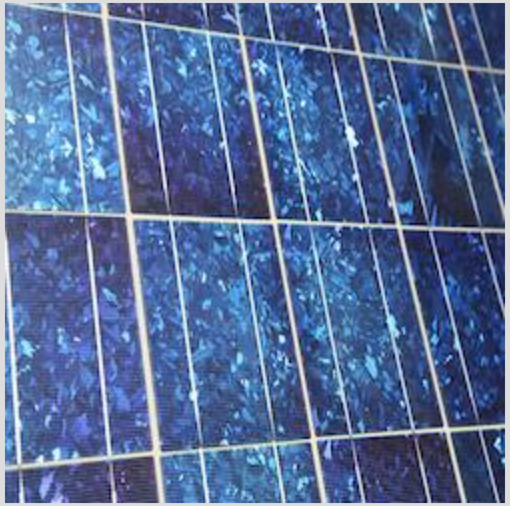
n.margaryan@yerphi.am

SILICON SOLAR CELLS

Monocrystalline Solar Cells

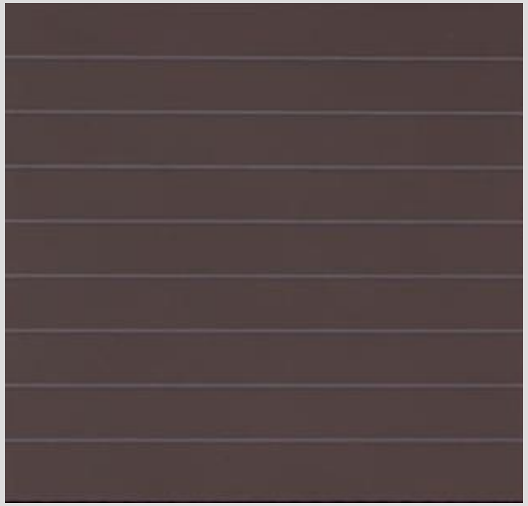
Very pure type of silicon makes them the most efficient material for converting sunlight into electricity. Warranties of up to 25 years.

Polycrystalline Solar Cells



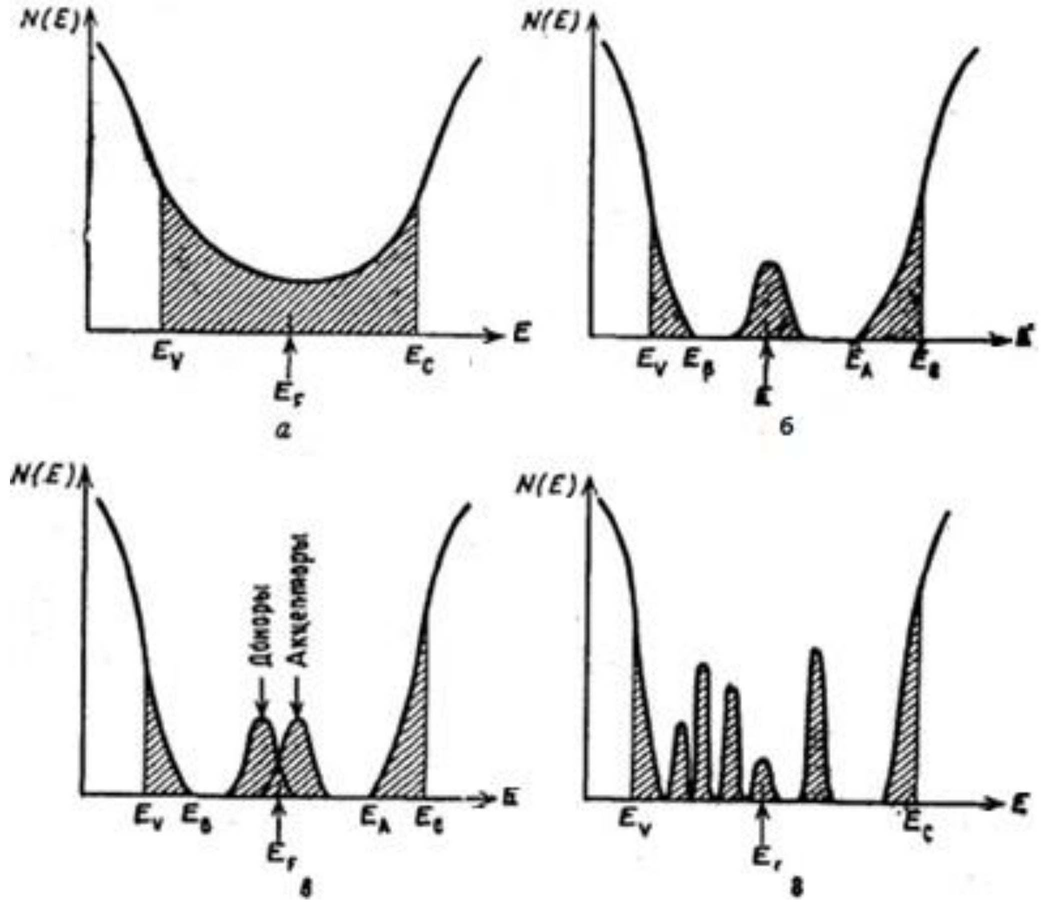
More affordable,
less efficient.

Amorphous Solar Cells

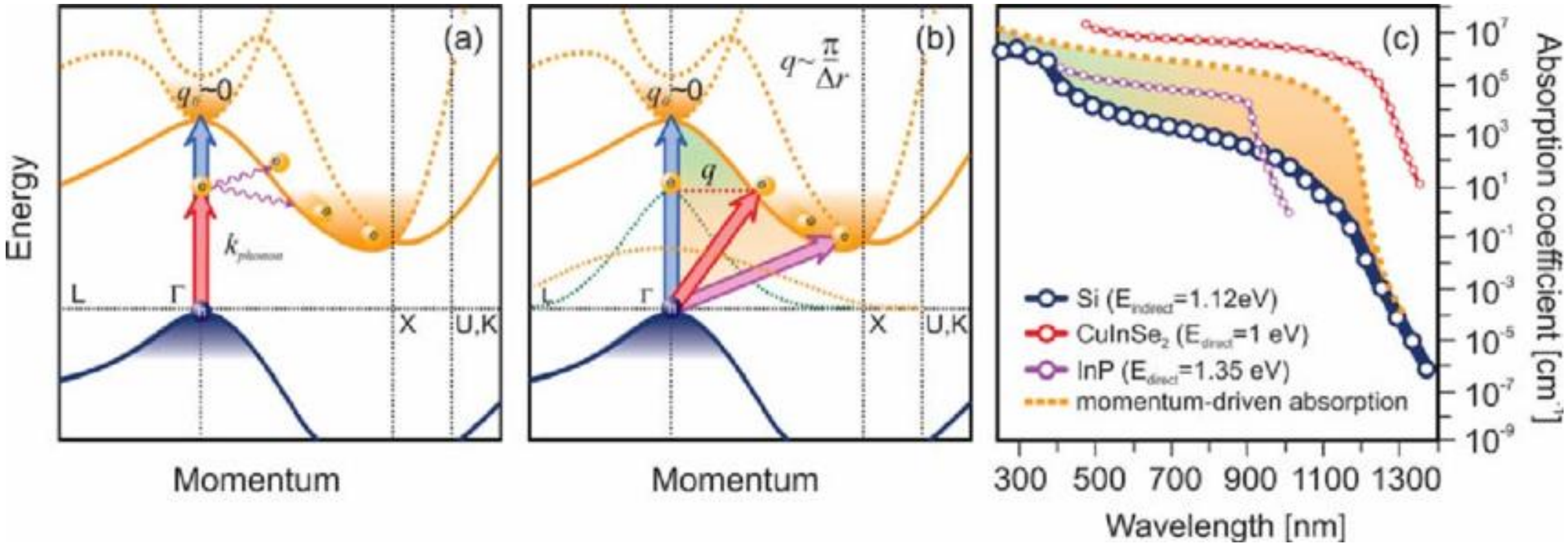


Amorphous silicon solar panels are a powerful and emerging line of photovoltaic systems that differ from crystalline silicon cells in terms of their output, structure, and manufacture.

MODELS OF COEN-FRITZSCHE AND DAVICE-MOTT



BAND STRUCTURE AND ELECTRON TRANSITIONS



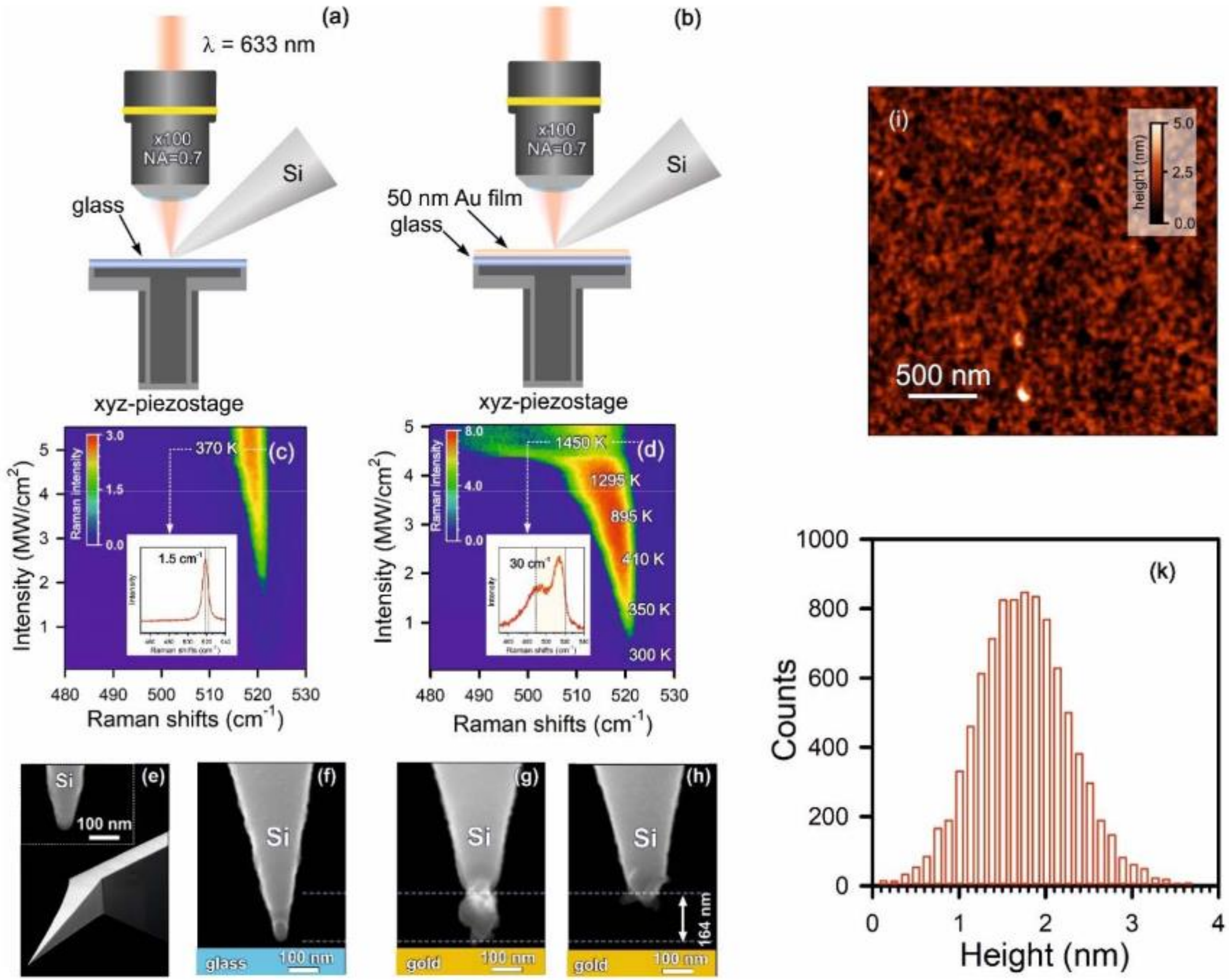
NUMERICAL ESTIMATES

$\Delta P\ (\Gamma\text{-}X) \sim \hbar\pi/a$

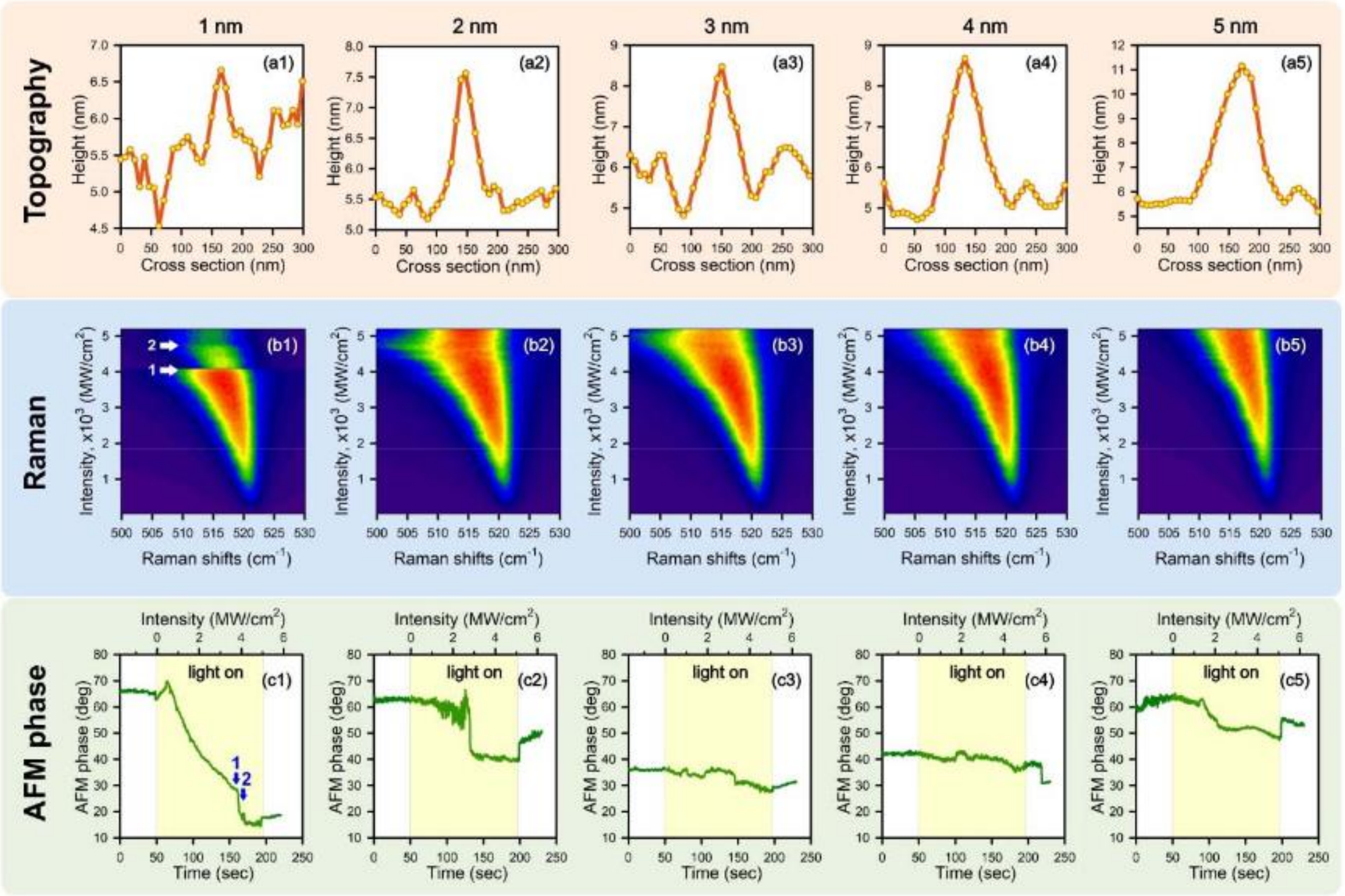
$\Delta P \sim \pi\hbar/\Delta r$

Δr	$\lambda\ (h\nu)$
0.7 nm	1130 nm (1.12 eV)
1.4 nm	633 nm (1.96 eV)
2.8 nm	532 nm (2.33 eV)

HEATING OF SILICON CANTILEVER THROUGH RAMAN THERMOMETRY



SENSING OF TIP APEX TEMPERATURE THROUGH RAMAN THERMOMETRY AND CANTILEVER PHASE TRANSITION



$E(r,t) = E_0\hat{e} \cdot \mathcal{E}(r)e^{-i\omega t}$, where ω is the angular frequency, $\hat{e}$ is the polarization state, $E_0 = \sqrt{\hbar\omega/(2V_0\varepsilon_0)}$, and $\mathcal{E}(r)$ is the spatial mode function. Fermi's golden rule for a transition from a given Bloch state $|v, k\rangle$ with crystal momentum vector k in the valence band all possible final states $|c, k'\rangle$ can then be written as:

$$W_{vc}(k) = \sum_{k'} \frac{2\pi}{3\hbar} \left(\frac{e}{\omega m}\right)^2 \left(\frac{\hbar\omega}{2V_0\varepsilon_0}\right) |\langle c, k'|\mathcal{E}(r) \cdot \hat{\mathrm{p}}|v, k\rangle|^2 \delta[\hbar\omega - E_{vc}(k, k')]$$

$$W_{vc}(k) \propto \frac{1}{V_0} |\mu_{cv}|^2 \delta[\hbar\omega - E_{vc}(k, k + q_0)] \quad ,$$

where $|\mu_{cv}|^2$ is the transition dipole moment. Since $q_0 \ll k$, only transitions for which $k' \approx k$ are optically allowed, which translates into vertical transitions. For the confined photon, we may assume the spatial mode function $\mathcal{E}(r)$ as a stationary Gaussian distribution with standard deviation σ_r:

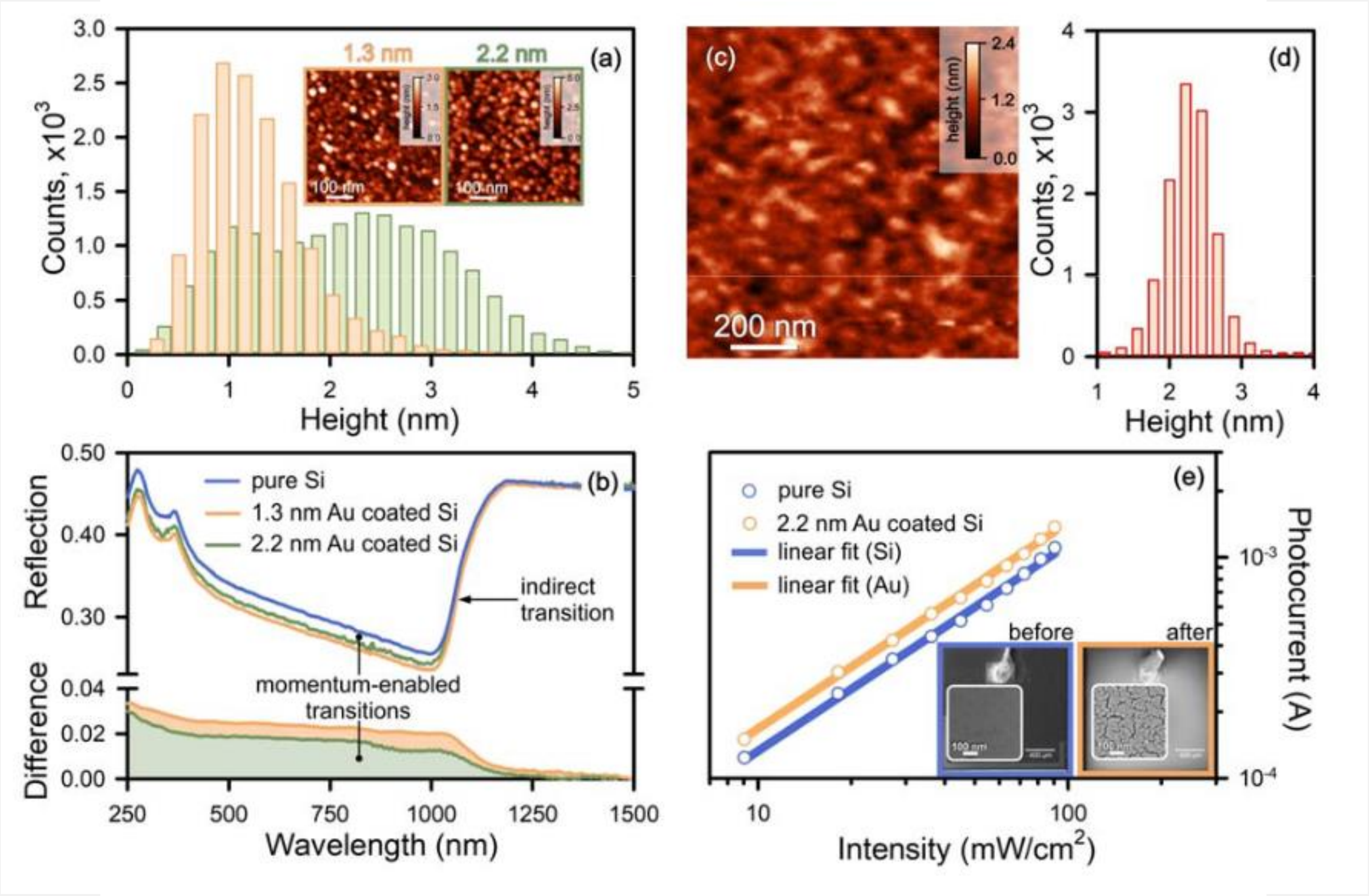
$$\mathcal{E}(r) = e^{-\frac{r^2}{(2\sigma_r)^2}} = \frac{1}{2\pi^2} \int G(q) e^{iqr} d^3q$$

which is written here in terms of a spherically-symmetric, three-dimensional Fourier transformation of the momentum distribution function $G(q)$. In this scenario, Equation (1) yields for the transition rate:

$$W_{vc}(k) \propto \frac{1}{V_e} |\mu_{cv}|^2 \int d^3q \, e^{-\frac{q^2}{(2\sigma_q)^2}} \delta[\hbar\omega - E_{vc}(k, k + q)]$$

INCREASE OF PHOTON MOMENTUM AND PURCELL EFFECT

REFLECTION AND PHOTOCURRENT



THANK YOU FOR ATTENTION!