6.2.1 Three-Dimensional Case

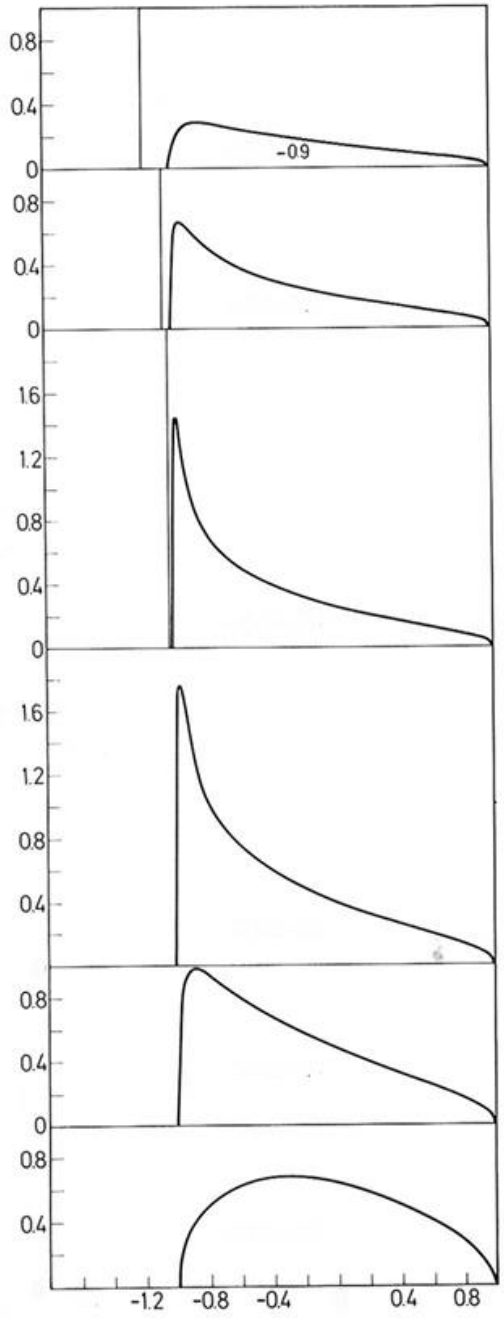


Fig.6.3. The perturbed DOS $\rho(\underline{\ell};E)$ vs. E for different values of the attractive local potential. As $|\epsilon|$ increases from zero, states are pushed towards the lower band edge and at a critical value ($|\epsilon|/B = 0.5$) a discrete level is split off the continuum. The unperturbed DOS $\rho_o(\underline{\ell};E)$ has been taken as in (5.55)

6.2.2 Two-Dimensional Case

Substituting in (6.9) we obtain

$$E_p - E_\ell \approx - C \exp\left(- \frac{1}{|\varepsilon| \rho_d}\right) \quad ; \quad \varepsilon \leq 0 \quad . \tag{6.44}$$

Thus the binding energy $|E_p - E_\ell|$ for weak perturbation depends exponentially on the strength of the perturbation. This dependence stems directly from the discontinuity of the unperturbed DOS at the band edge, which in turn is a characteristic feature of two-dimensional systems. For the case of the

6.2.3 One-Dimensional Case

Thus both I_ℓ and I_u are infinite, and consequently there is always a bound state no matter how small $|\varepsilon|$ is. For small negative ε the bound level is very close to the band edge and thus one can use expression (6.47) in (6.9). We then obtain for the binding energy E_b the following expression

$$E_b = |E_p - E_\ell| \xrightarrow[\varepsilon \to 0^-]{} \varepsilon^2 \pi^2 C^2 \quad . \tag{6.48}$$

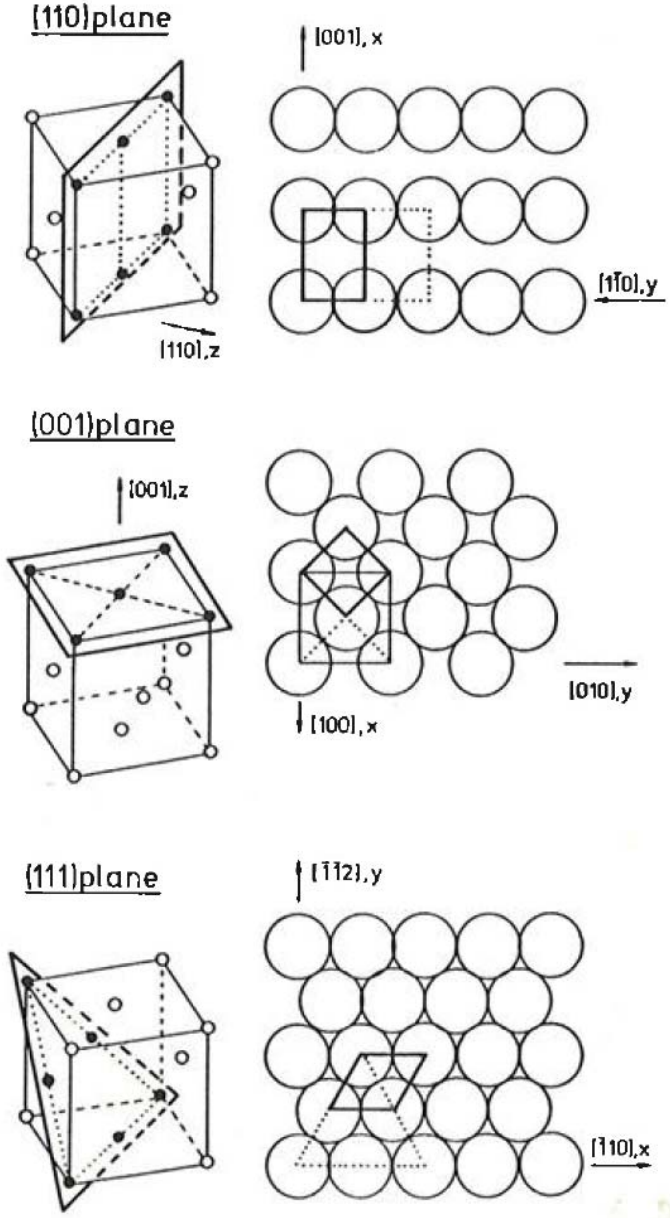


Fig.8.5. (100), (001) and (111) surfaces of a fcc crystal. *Left*: (110), (001) and (111) cuts through the crystal unit cell and atomic arrangement in the plane of the section. *Right*: Surface Brillouin zones corresponding to the cuts on the left-hand side [8.23]

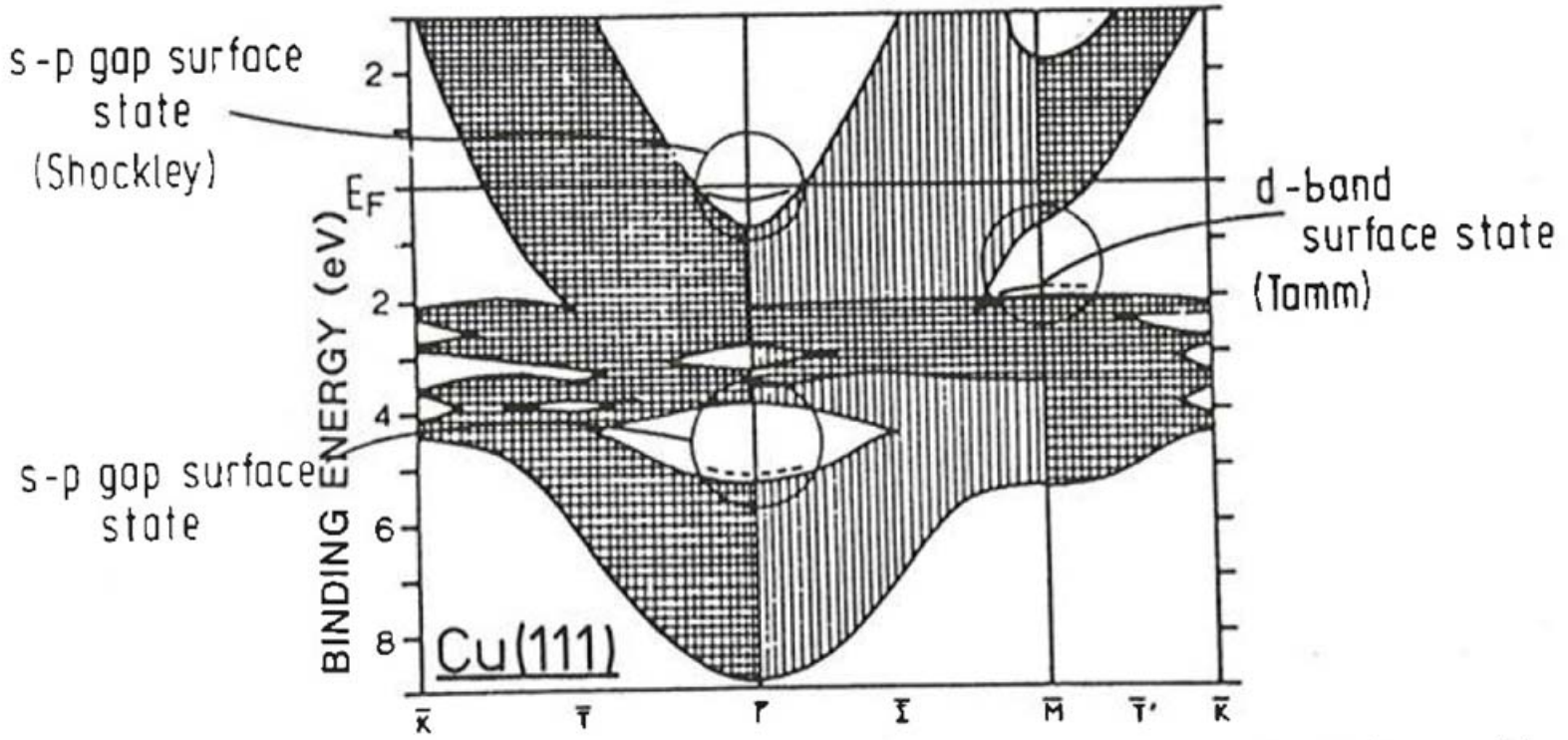
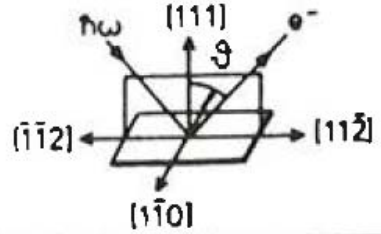
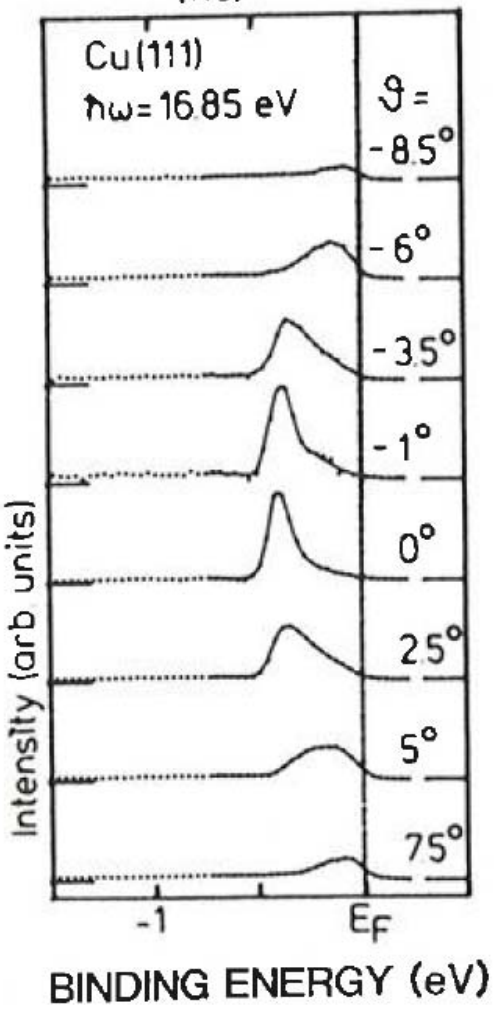
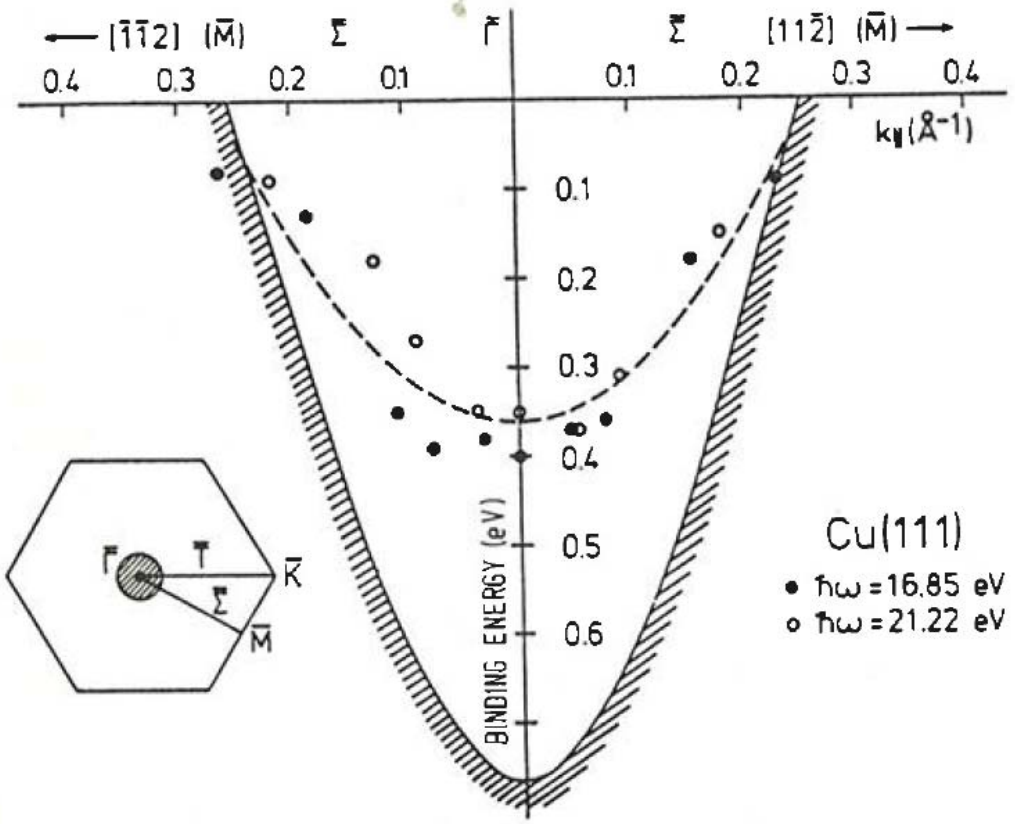


Fig.8.6. Density of states of Cu projected onto the (111) plane [8.23]. This provides the gaps in which a surface state can be expected to show up: near $\bar{\Gamma}$ with binding energies $E_F \leq E_s \leq 1eV$, near $\bar{\Gamma}$ with $3.7eV \leq E_s \leq 5.1eV$ and near $\bar{M}$ with $1eV \leq E_s \leq 2eV$


ħω
[111]
ϑ
e⁻
[1̄1̄2]
[112̄]
[1̄10]


Cu(111)
ħω = 16.85 eV
ϑ =
-8.5°
-6°
-3.5°
-1°
0°
2.5°
5°
7.5°
Intensity (arb units)
-1
E_F
BINDING ENERGY (eV)


[1̄1̄2] (M̄)
Σ̄
Γ̄
Σ̄
[11̄2] (M̄)
0.4
0.3
0.2
0.1
0.1
0.2
0.3
0.4
k_y (Å⁻¹)
0.1
0.2
0.3
0.4
0.5
0.6
BINDING ENERGY (eV)
Γ̄
T̄
K̄
Σ̄
M̄
Cu(111)
• ħω = 16.85 eV
○ ħω = 21.22 eV