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A simple consistent picture emerges. Surface
plasmons are damped above the interband transi-
tion in Au and Cu. The effect is seen as a rather

clear image of the electron energy-loss function
in the spectrum of light emitted from tunnel junc-
tions. The findings are in harmony with surface-enhanced Raman spectroscopy data.
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ical bonds, '

localized defects, '

and the interface

geometry. ' Following these experiments, cur-
rent theoretical models"

"

analyze the SB prop-
erties in terms of strong chemisorption bonds be-
tween an

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age -step states. '
Figure 2 shows Al 2p spectra corresponding to
the three different Al adsorption states on GaAs-
(110). We see that the Al 2p peak shifts in ener-

gy by several tenths of an electronvolt as the
coverage increases from 0.05 to 1 monolayer. The shift is over and above the shift caused by the Al-induced band bending (see Fig. 1). To eliminate band-bending effects, each peak in Fig. 2 was shifted by an amount equal to the differ-
ence in band bending between the corresponding
interface and the thick-Al interface. The band

bending was deduced for each Al coverage from
the shift of the metal-covered-surface Ga 3d

peak with respect to the clean-surface Ga 3d

Ga As (110)
+AC

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&u=120eV

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X50

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E(eV)

0

FIG. 2. Photoemission spectra of the Al 2p core
level, illustrating the three different Al adsorption states as a function of coverage. The top spectrum cor-responds to bulk Al, and the zero of the energy scale is set to coincide with this bulk-Al peak. The band-bending correction is very small for the monolayer-coverage peak, while for the 0.05-monolayer spectrum it is illustrated by the vertical dashed and solid straight
lines. The shift (over and above the band bending) be-
tween the bottom and middle peaks demonstrates that
two different adsorption states occur for Al, one below
and one above -0.1 monolayer coverage. The dashed
lines show the estimated secondary-electron back-
ground by linear interpolation.

Ga As (110)+AX
$~ = 120eV

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8=0.8..

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«« ~ ~ ~

e\

8 =0.2 I« ~

«~ ~
~ W« ~««««««««

X4
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~ ««
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~ ~

9=0.05 r---—

x8
e 0025
X16

~ ~

1

-4 I

-2 0
E(t.V)

FIG. 3. Evolution from the initial Al adsorption state
to the intermediate Al adsorption state. The energy

VGLUME 49, NUMBER 12 PHYSICAL REVIEW LETTERS 20 SEPTEMBER 1982 known formation of bulk Al accompanied