seen by the variety loys [3], this model

al belly and necks nduction electrons s of the individual ual resistivity can

(4)

cons, respectively. 100 seek conductivity (Au alloys,  $\varrho_0/\varrho_0^B$ ). Thus, the belly er, this does not eglected without use of uncharged to the immediate e in between the attered and the tion time for the ing tends to be glected to a first

nearly the same ly is about 25% is less sensitive /dV was nearly ppears that the effect in deter- V in the noble

oys the use of Du Charme and rmulation that r for accurately ite noble metal the case of the y and experibys the theory

well impurity na related to u alloys. He is model it is r = -U for mic cell. The

effective impurity potential accounting for electron screening is given by

$$v(q) = v_0(q)/\varepsilon(q) . (5)$$

Here  $v_0(q)$  is the Fourier transform of  $v_0(r)$ 

$$v(q) = -4 \pi U \frac{\sin q \, r_{\rm s} - q \, r_{\rm s} \cos q \, r_{\rm s}}{q^3}, \tag{6}$$

and  $\varepsilon(q)$  is the dielectric constant in the random phase approximation.

$$\varepsilon(q) = 1 + \frac{4 e^2 m k_F}{\pi h^2 q^2} \left[ \frac{1}{2} + \frac{k_F}{2 q} \left( 1 - \frac{q^2}{4 k_F^2} \right) \ln \left| \frac{q + 2 k_F}{q - 2 k_F} \right| \right], \tag{7}$$

where  $k_{\rm F}$  is the Fermi wave vector. If it is assumed that the Fermi surface is spherical (i.e. neglecting the neck electrons in the noble metal alloys) the resistivity can be calculated from [16]

$$\varrho_0 = \frac{c (1 - c) m^2}{4 \pi h^3 k_F^3} \int_0^{2k_F} |v(q)|^2 q^3 dq , \qquad (8)$$

where c is the concentration of Au atoms.

The volume derivative of (8) is easily shown to be

$$\frac{\mathrm{d}\ln\varrho_{0}}{\mathrm{d}\ln V} = -5\frac{\mathrm{d}\ln k_{\mathrm{F}}}{\mathrm{d}\ln V} - 2\frac{\int_{0}^{2}\mathrm{d}x\frac{(\sin\alpha x - \alpha x\cos\alpha x)^{2}}{x^{3}\varepsilon^{2}(x)}\frac{\mathrm{d}\ln\varepsilon(x)}{\mathrm{d}\ln V}}{\int_{0}^{2}\mathrm{d}x\frac{(\sin\alpha x - \alpha x\cos\alpha x)^{2}}{x^{3}\varepsilon^{2}(x)}},$$
(9)

where  $x \equiv q/k_{\rm F}$ ,  $\alpha \equiv k_{\rm F} r_{\rm s}$ ,

$$\frac{\mathrm{d}\ln\varepsilon(x)}{\mathrm{d}\ln V} = \frac{1}{3} \left[ 1 + \frac{\pi \, h^2 \, k_{\mathrm{F}}}{2 \, m \, e^2} \left( \frac{x^2}{1 + \frac{(1 - x^2/4)}{x} \ln\left|\frac{1 + x/2}{1 - x/2}\right|} \right) \right]^{-1},\tag{10}$$

and U is assumed to be independent of volume and concentration. In the free electron approximation d  $\ln k_{\rm F}/{\rm d} \ln V = -1/3$ . The integrals can be evaluated numerically if  $k_{\rm F}$  and  $r_{\rm s}$  are known; for both Ag and Au  $k_{\rm F} = 1.20~{\rm \AA}^{-1}$  and  $r_{\rm s} = 1.59~{\rm \AA}$  [18]. Evaluating the integrals yield d  $\ln \varrho_0/{\rm d} \ln V = 1.38$  for all Ag-Au alloys. As seen in Table 1 this is in general agreement with the experimental values; however, this model does not predict the concentration dependence. A similar calculation using this model was made for the Cu-Ag and Cu-Au alloys; in these cases the model predicted both the wrong sign and magnitude (in the case of the pseudopotential calculations [15] agreement between theory and experiment was obtained for the Cu-Ag alloys, but not the Ag-Au alloys).

These discrepancies in the theoretical prediction (from both models) are not too surprising because the effect of the low lying filled d-bands on the scattering potential was not explicitly considered. It is well known that the filled d-bands in the noble metals strongly interact with the conduction electrons in certain directions [1, 17]. From optical measurements [19] it has been shown that the d-levels of Cu and Ag do not overlap and form separate d-states in the alloys,