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OPTICAL PROPERTIES OF THE METALS Al, Co, Cu, Au, Fe, Pb, Ni, Pd, Pt, Ag, Ti AND W IN THE INFRARED AND FAR INFRARED

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Infrared optical constants collected from the literature are tabulated. The data for the noble metals and Al, Pb, and W can be reeasonably fit using the Drude model. It is shown that $-\varepsilon_1(\omega) = \varepsilon_2(\omega) \cong \omega_p^2/(2\omega_\tau^2)$ at the damping frequency $\omega = \omega_\tau$. Also $-\varepsilon_1(\omega_\tau) \cong -(1/2)\,\varepsilon_1(0)$ where the plasma frequency is ω_p.

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PREFACE

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OPTICAL PROPERTIES OF THE METALS Al, Co, Cu, Au, Fe, Pb, Ni, Pd, Pt, Ag, Ti AND W IN THE INFRARED AND FAR INFRARED

1. INTRODUCTION

Many measurements of the optical constants of metals have been made, primarily at near infrared, visible and ultraviolet wavelengths. Sievers and his coworkers[1] have measured Au and Pb in the far infrared. We have compiled this data and have tabulated the real and imaginary parts of the dielectric function, ϵ_1 and ϵ_2, respectively, the index of refraction, n, and the extinction index, k, for each metal in the infrared. Drude model[2-4] parameters giving a reasonable fit to the data are given for Au, Ag, Cu, Al, Pb, and W. In general, the Drude model is not expected to be appropriate for transition metals in the near and middle infrared, but a good fit to the measurements can be obtained for W with a Drude model dielectric function. A table of ϵ_1, ϵ_2, n and k is given for each metal, calculated from the Drude model using parameters obtained from fitting the measured values.

Weaver, Krafka, Lynch, and Koch[5] have compiled extensive tables of optical properties of metals which have been recently published. Most of their tables do not extend beyond 12 micrometers wavelength; our compilation extends to the longest wavelength for which data is available. For the noble metals, Dold and Mecke[6] compiled tables of n and k in 1965.

H. E. and J. M. Bennett[7] have shown that the Drude model fits the measured reflectance of gold, silver and aluminum in the 3 to 30 micrometer wavelength range with one adjustable parameter; i.e., the Drude model parameters were obtained from the dc resistivity and fitted with one free electron per atom for gold and silver and 2.6 free electrons per atom for aluminum. Brändli and Sievers have shown that the Drude model is an excellent fit to their far infrared measurements on lead and provides a good fit for gold with no adjustable parameters.

2. DEFINITIONS AND EQUATIONS

In keeping with infrared spectroscopic notation, all frequencies will be expressed in cm^{-1}. The complex dielectric function, ϵ_c, and the complex index of refraction, n_c, are defined as:

$$\epsilon_c \equiv \epsilon_1 + i\epsilon_2 \equiv n_c^2 \equiv (n + ik)^2. \qquad (1)$$

The Drude model dielectric function is

$$\epsilon_c = \epsilon_\infty - \frac{\omega_p^2}{\omega^2 + i\omega\omega_\tau} \qquad (2)$$

where ω, ω_p and ω_τ have units of cm^{-1}. Separating the real and imaginary parts yields

$$\epsilon_1 = \epsilon_\infty - \frac{\omega_p^2}{\omega^2 + \omega_\tau^2} \qquad (3)$$

and

$$\epsilon_2 = \frac{\omega_p^2\omega_\tau}{\omega^3 + \omega\omega_\tau^2} \; . \qquad (4)$$

In these equations, the plasma frequency[8] is

$$\omega_p^2 = 4\pi Ne^2/m^* \qquad (5)$$

and the scattering frequency is

$$\omega_\tau(cm^{-1}) = \frac{1}{2\pi ct} \qquad (6)$$

where τ is the electron lifetime in seconds and c is the velocity of light in cm/sec. Note that for low frequencies

$$\epsilon_1(0) \to - \left[\frac{\omega_p}{\omega_\tau}\right]^2 \quad . \tag{7}$$

The dc conductivity, σ_o, is related to ω_τ by

$$\sigma_o = \frac{\omega_p^2}{4\pi\omega_\tau} \tag{8}$$

with σ_o having units of cm^{-1}. This can be expressed in terms of the dc resistivity, ρ_o:

$$\sigma_o(cm^{-1}) = \frac{1}{2\pi c[\rho_o(sec)]} = \frac{9 \times 10^{11}}{2\pi c[\rho_o(\Omega\ cm)]} \tag{9}$$

In order to analyze the data of Sievers and Brändli,[1] it is convenient to write the surface impedance, $Z(\omega) = R(\omega) + iX(\omega)$, for the Drude model:[4]

$$Z(\omega) = \frac{4\pi}{c}(1-i)\left[\frac{\omega\omega_\tau}{2\omega_p^2}\right]^{\frac{1}{2}}\sqrt{1 - i\frac{\omega}{\omega_\tau}} \tag{10}$$

We shall need only $R(\omega)$:

$$R(\omega) = \frac{4\pi}{c}\left[\frac{\omega\omega_\tau}{2\omega_p^2}\right]^{\frac{1}{2}}\left\{\frac{-\omega}{\omega_\tau} + \sqrt{1 + \frac{\omega^2}{\omega_\tau^2}}\right\}^{\frac{1}{2}} \quad . \tag{11}$$

3. DETERMINATION OF DRUDE MODEL PARAMETERS

All data in the form of n and k was changed to ϵ_1 and ϵ_2. Eqs. (3) and (4) were solved for ω_τ, eliminating ω_p:

$$\omega_\tau = \frac{\omega\epsilon_2}{\epsilon_\infty - \epsilon_1} \tag{12}$$

This equation was solved to determine ω_τ using ϵ_1 and ϵ_2 at some frequency ω. Then ω_p was obtained from

$$\omega_p^2 = (\epsilon_\infty - \epsilon_1)\ (\omega^2 + \omega_\tau^2) \qquad (13)$$

Due to a lack of reliable data ϵ_∞ was taken to be unity. Eqs. (11) and (12) were applied to the data at several values of ω to obtain the ω_τ and ω_p values which produced the curve with the best "eyeball" fit to the data.

The one exception to this process was the measurements of Brändli and Sievers[1] for Au and Pb. They reported values of $R(\omega)/Z_o$ where $Z_o = 4\pi/c$. For the far infrared, Equation (11) reduces to

$$\frac{R(\omega)}{Z_o} = \left(\frac{\omega\omega_\tau}{2\omega_p^2}\right)^{\frac{1}{2}} \quad . \qquad (14)$$

ω_τ was obtained from this data using ω_p from the near infrared fit. This value of ω_τ was used for gold and lead rather than the ω_τ obtained from the near infrared fit.

We note from Eq. (12) that the frequency for which $-\epsilon_1(\omega) = \epsilon_2(\omega)$ is very nearly $\omega = \omega_\tau$ since $-\epsilon_1 >> 1$. With $\omega = \omega_\tau$ both components ($-\epsilon_1$ and ϵ_2) of the dielectric function are $\omega_p^2/(2\omega_\tau^2)$. Thus the Drude parameters, ω_τ and ω_p, can be determined at the crossover from $\omega = \omega_\tau$ and the value of the dielectric function. Note that $-\epsilon_1(0) \simeq \omega_p^2/\omega_p^2$; so, $-1/2\epsilon_1(0) \simeq -\epsilon_1(\omega_\tau)$.

4. THE DATA

Figures 1 through 12 are plots of $-\epsilon_1(\omega)$ for the 12 metals. The high frequency termination occurs where the Drude model becomes invalid. The solid lines are calculated from the Drude model with the parameters listed in Table 13. Tables 1 through 12 present the collected values of ϵ_1, ϵ_2, n, and k. Table 13 summarizes the Drude model parameters from our fit (for Ag, Au, Cu, Al, Pb and W) as well as ω_τ calculated from ω_p and the AIP

handbook[9] values of the dc resistivity. Dielectric functions for all metals considered in this article except Pb have been tabulated by Weaver et al.[5] for the uv, visible and near IR.

Finally, we disclaim any physical significance for the Drude model. The intent is only to parametrize the optical constants for these metals even when there is some question as to the physical meaning of the parameters. The transition metals show interband transitions and cannot be fit with a Drude model in the infrared (with the exception of W). Even the noble metals in the IR can have small interband contributions to the dielectric constants.[10]

TABLE 1. ALUMINUM (Al)

ω(cm^{-1})	λ(μm)	$-\epsilon_1$	ϵ_2	n	k
3.23E+02	3.10E+01	3.18E+04	4.02E+04	9.86E+01	2.04E+02
3.39E+02	2.95E+01	3.01E+04	3.62E+04	9.22E+01	1.96E+02
3.71E+02	2.70E+01	2.68E+04	3.03E+04	8.26E+01	1.83E+02
4.03E+02	2.48E+01	2.43E+04	2.59E+04	7.50E+01	1.73E+02
4.36E+02	2.30E+01	2.14E+04	2.24E+04	6.93E+01	1.62E+02
4.68E+02	2.14E+01	1.95E+04	2.01E+04	6.52E+01	1.54E+02
5.00E+02	2.00E+01	1.80E+04	1.79E+04	6.07E+01	1.47E+02
5.32E+02	1.88E+01	1.66E+04	1.60E+04	5.67E+01	1.41E+02
5.81E+02	1.72E+01	1.50E+04	1.38E+04	5.20E+01	1.33E+02
6.45E+02	1.55E+01	1.32E+04	1.13E+04	4.58E+01	1.24E+02
7.10E+02	1.41E+01	1.18E+04	9.49E+03	4.09E+01	1.16E+02
7.74E+02	1.29E+01	1.05E+04	7.89E+03	3.62E+01	1.09E+02
8.87E+02	1.13E+01	8.77E+03	5.94E+03	3.02E+01	9.84E+01
1.05E+03	9.54E+00	6.93E+03	4.07E+03	2.35E+01	8.65E+01
1.21E+03	8.27E+00	5.58E+03	2.86E+03	1.86E+01	7.70E+01
1.37E+03	7.29E+00	4.51E+03	2.05E+03	1.49E+01	6.88E+01
1.61E+03	6.20E+00	3.39E+03	1.39E+03	1.17E+01	5.94E+01
2.02E+03	4.96E+00	2.25E+03	8.28E+02	8.59E+00	4.82E+01
2.42E+03	4.13E+00	1.63E+03	5.54E+02	6.76E+00	4.10E+01
2.82E+03	3.54E+00	1.24E+03	3.87E+02	5.44E+00	3.56E+01
3.23E+03	3.10E+00	9.71E+02	2.80E+02	4.45E+00	3.15E+01
4.84E+03	2.07E+00	4.53E+02	9.73E+01	2.27E+00	2.14E+01
6.45E+03	1.55E+00	2.52E+02	4.61E+01	1.44E+00	1.60E+01
8.07E+03	1.24E+00	1.54E+02	3.02E+01	1.21E+00	1.25E+01
1.21E+04	8.27E-01	6.15E+01	4.56E+01	2.75E+00	8.31E+00
1.61E+04	6.20E-01	5.42E+01	1.95E+01	1.30E+00	7.48E+00

SOURCE: Reference 11

TABLE 1. ALUMINUM (Al) (Continued)

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
3.13E+02	3.20E+01	2.60E+04	5.56E+04	1.33E+02	2.09E+02
3.23E+02	3.10E+01	2.58E+04	5.31E+04	1.29E+02	2.06E+02
3.33E+02	3.00E+01	2.56E+04	5.08E+04	1.25E+02	2.03E+02
3.45E+02	2.90E+01	2.54E+04	4.84E+04	1.21E+02	2.00E+02
3.57E+02	2.80E+01	2.47E+04	4.59E+04	1.17E+02	1.96E+02
3.70E+02	2.70E+01	2.45E+04	4.36E+04	1.13E+02	1.93E+02
3.85E+02	2.60E+01	2.38E+04	4.12E+04	1.09E+02	1.89E+02
4.00E+02	2.50E+01	2.36E+04	3.91E+04	1.05E+02	1.86E+02
4.17E+02	2.40E+01	2.31E+04	3.64E+04	1.00E+02	1.82E+02
4.35E+02	2.30E+01	2.25E+04	3.42E+04	9.60E+01	1.78E+02
4.55E+02	2.20E+01	2.19E+04	3.18E+04	9.15E+01	1.74E+02
4.76E+02	2.10E+01	2.10E+04	2.93E+04	8.68E+01	1.69E+02
5.00E+02	2.00E+01	2.05E+04	2.71E+04	8.21E+01	1.65E+02
5.26E+02	1.90E+01	1.96E+04	2.47E+04	7.73E+01	1.60E+02
5.56E+02	1.80E+01	1.88E+04	2.24E+04	7.24E+01	1.55E+02
5.88E+02	1.70E+01	1.80E+04	2.02E+04	6.74E+01	1.50E+02
6.25E+02	1.60E+01	1.69E+04	1.79E+04	6.23E+01	1.44E+02
6.67E+02	1.50E+01	1.58E+04	1.58E+04	5.71E+01	1.38E+02
7.14E+02	1.40E+01	1.47E+04	1.37E+04	5.19E+01	1.32E+02
7.69E+02	1.30E+01	1.37E+04	1.18E+04	4.67E+01	1.26E+02
8.33E+02	1.20E+01	1.24E+04	9.88E+03	4.15E+01	1.19E+02
9.09E+02	1.10E+01	1.10E+04	8.06E+03	3.63E+01	1.11E+02
1.00E+03	1.00E+01	9.84E+03	6.49E+03	3.12E+01	1.04E+02
1.11E+03	9.00E+00	8.41E+03	5.02E+03	2.63E+01	9.54E+01
1.25E+03	8.00E+00	7.02E+03	3.72E+03	2.15E+01	8.65E+01

SOURCE: Reference 7

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
1.05E+04	9.50E-01	6.92E+01	2.98E+01	1.75E+00	8.50E+00
1.11E+04	9.00E-01	5.54E+01	3.02E+01	1.96E+00	7.70E+00
1.18E+04	8.50E-01	4.68E+01	2.97E+01	2.08E+00	7.15E+00
1.25E+04	8.00E-01	4.57E+01	2.81E+01	1.99E+00	7.05E+00
1.33E+04	7.50E-01	4.75E+01	2.56E+01	1.80E+00	7.12E+00
1.43E+04	7.00E-01	4.66E+01	2.17E+01	1.55E+00	7.00E+00
1.54E+04	6.50E-01	4.20E+01	1.64E+01	1.24E+00	6.60E+00
1.67E+04	6.00E-01	3.51E+01	1.16E+01	9.70E-01	6.00E+00
1.82E+04	5.50E-01	2.77E+01	8.09E+00	7.60E-01	5.32E+00
2.00E+04	5.00E-01	2.27E+01	5.95E+00	6.20E-01	4.80E+00
2.22E+04	4.50E-01	1.84E+01	4.23E+00	4.90E-01	4.32E+00
2.50E+04	4.00E-01	1.52E+01	3.14E+00	4.00E-01	3.92E+00

SOURCE: Reference 12

TABLE 2. COPPER (Cu)

ω(cm^{-1})	λ(μm)	$-\epsilon_1$	ϵ_2	n	k
1.05E+04	9.50E-01	3.87E+01	1.62E+00	1.30E-01	6.22E+00
1.11E+04	9.00E-01	3.43E+01	1.52E+00	1.30E-01	5.86E+00
1.18E+04	8.50E-01	2.99E+01	1.31E+00	1.20E-01	5.47E+00
1.25E+04	8.00E-01	2.57E+01	1.22E+00	1.20E-01	5.07E+00
1.33E+04	7.50E-01	2.13E+01	1.11E+00	1.20E-01	4.62E+00
1.43E+04	7.00E-01	1.74E+01	1.00E+00	1.20E-01	4.17E+00
1.54E+04	6.50E-01	1.33E+01	9.49E-01	1.30E-01	3.65E+00
1.67E+04	6.00E-01	9.40E+00	1.04E+00	1.70E-01	3.07E+00
1.82E+04	5.50E-01	5.34E+00	3.48E+00	7.20E-01	2.42E+00
2.00E+04	5.00E-01	5.08E+00	4.26E+00	8.80E-01	2.42E+00
2.22E+04	4.50E-01	4.08E+00	3.83E+00	8.70E-01	2.20E+00

SOURCE: Reference 12

ω(cm^{-1})	λ(μm)	$-\epsilon_1$	ϵ_2	n	k
5.00E+02	2.00E+01	1.35E+04	7.61E+03	3.16E+01	1.20E+02
5.56E+02	1.80E+01	1.15E+04	6.11E+03	2.76E+01	1.11E+02
6.25E+02	1.60E+01	9.00E+03	4.64E+03	2.37E+01	9.78E+01
7.14E+02	1.40E+01	6.80E+03	3.36E+03	1.98E+01	8.48E+01
8.33E+02	1.20E+01	5.05E+03	2.29E+03	1.57E+01	7.28E+01
1.00E+03	1.00E+01	3.50E+03	1.40E+03	1.16E+01	6.03E+01
1.25E+03	8.00E+00	2.20E+03	7.28E+02	7.66E+00	4.75E+01
1.67E+03	6.00E+00	1.30E+03	3.24E+02	4.46E+00	3.63E+01
2.00E+03	5.00E+00	1.00E+03	1.40E+02	2.21E+00	3.17E+01
2.50E+03	4.00E+00	6.22E+02	8.80E+01	1.76E+00	2.50E+01

SOURCE: Reference 13

ω(cm^{-1})	λ(μm)	$-\epsilon_1$	ϵ_2	n	k
1.56E+04	6.40E-01	7.69E+00	1.70E+00	3.04E-01	2.79E+00
1.67E+04	6.00E-01	5.98E+00	1.70E+00	3.44E-01	2.47E+00
1.79E+04	5.60E-01	4.09E+00	2.20E+00	5.26E-01	2.09E+00
1.92E+04	5.20E-01	3.71E+00	6.99E+00	1.45E+00	2.41E+00
2.08E+04	4.80E-01	3.10E+00	7.01E+00	1.51E+00	2.32E+00
2.27E+04	4.40E-01	2.39E+00	6.79E+00	1.55E+00	2.19E+00
2.50E+04	4.00E-01	1.81E+00	5.92E+00	1.48E+00	2.00E+00

SOURCE: Reference 14

TABLE 2. COPPER (Cu) (Continued)

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
8.07E+02	1.24E+01	4.24E+03	4.25E+03	2.97E+01	7.16E+01
4.03E+03	2.48E+00	3.08E+02	6.03E+01	1.71E+00	1.76E+01
8.07E+03	1.24E+00	7.17E+01	7.46E+00	4.40E-01	8.48E+00
1.21E+04	8.27E-01	2.76E+01	2.74E+00	2.60E-01	5.26E+00
1.37E+04	7.29E-01	1.96E+01	1.95E+00	2.20E-01	4.43E+00
1.41E+04	7.08E-01	1.80E+01	1.79E+00	2.10E-01	4.25E+00
1.45E+04	6.89E-01	1.63E+01	1.70E+00	2.10E-01	4.04E+00
1.49E+04	6.70E-01	1.48E+01	1.69E+00	2.20E-01	3.85E+00
1.53E+04	6.53E-01	1.34E+01	1.54E+00	2.10E-01	3.67E+00
1.61E+04	6.20E-01	1.04E+01	1.75E+00	2.70E-01	3.24E+00

SOURCE: Reference 15

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
1.00E+03	1.00E+01	2.27E+03	1.14E+03	1.16E+01	4.90E+01
1.11E+03	9.00E+00	1.99E+03	9.05E+02	9.90E+00	4.57E+01
1.25E+03	8.00E+00	1.66E+03	6.72E+02	8.10E+00	4.15E+01
1.43E+03	7.00E+00	1.31E+03	4.71E+02	6.40E+00	3.68E+01
1.67E+03	6.00E+00	9.99E+02	3.17E+02	4.95E+00	3.20E+01
2.00E+03	5.00E+00	6.95E+02	1.92E+02	3.60E+00	2.66E+01
2.50E+03	4.00E+00	4.56E+02	1.05E+02	2.45E+00	2.15E+01
3.33E+03	3.00E+00	2.54E+02	4.80E+01	1.50E+00	1.60E+01
5.00E+03	2.00E+00	1.12E+02	1.80E+01	8.50E-01	1.06E+01
6.67E+03	1.50E+00	6.37E+01	9.28E+00	5.80E-01	8.00E+00
8.00E+03	1.25E+00	4.46E+01	6.57E+00	4.90E-01	6.70E+00

SOURCE: Reference 6

TABLE 3. GOLD (Au)

ω(cm^{-1})	λ(μm)	$-\epsilon_1$	ϵ_2	n	k
3.13E+02	3.20E+01	3.69E+04	2.54E+04	6.28E+01	2.02E+02
3.33E+02	3.00E+01	3.37E+04	2.17E+04	5.66E+01	1.92E+02
3.57E+02	2.80E+01	3.06E+04	1.84E+04	5.05E+01	1.82E+02
3.85E+02	2.60E+01	2.73E+04	1.53E+04	4.46E+01	1.71E+02
4.17E+02	2.40E+01	2.41E+04	1.24E+04	3.89E+01	1.60E+02
4.55E+02	2.20E+01	2.08E+04	9.89E+03	3.34E+01	1.48E+02
5.00E+02	2.00E+01	1.77E+04	7.67E+03	2.82E+01	1.36E+02
5.56E+02	1.80E+01	1.48E+04	5.78E+03	2.33E+01	1.24E+02
6.25E+02	1.60E+01	1.22E+04	4.19E+03	1.87E+01	1.12E+02
7.14E+02	1.40E+01	9.51E+03	2.86E+03	1.45E+01	9.86E+01
8.33E+02	1.20E+01	7.14E+03	1.84E+03	1.08E+01	8.52E+01
1.00E+03	1.00E+01	5.05E+03	1.09E+03	7.62E+00	7.15E+01
1.25E+03	8.00E+00	3.29E+03	5.68E+02	4.93E+00	5.76E+01
1.43E+03	7.00E+00	2.54E+03	3.83E+02	3.79E+00	5.05E+01
1.67E+03	6.00E+00	1.88E+03	2.42E+02	2.79E+00	4.34E+01
2.00E+03	5.00E+00	1.31E+03	1.41E+02	1.95E+00	3.62E+01
2.50E+03	4.00E+00	8.39E+02	7.25E+01	1.25E+00	2.90E+01
3.33E+03	3.00E+00	4.75E+02	3.07E+01	7.04E-01	2.18E+01

SOURCE: Reference 7

ω(cm^{-1})	λ(μm)	$-\epsilon_1$	ϵ_2	n	k
1.05E+04	9.50E-01	3.72E+01	2.32E+00	1.90E-01	6.10E+00
1.11E+04	9.00E-01	3.27E+01	2.06E+00	1.80E-01	5.72E+00
1.25E+04	8.00E-01	2.34E+01	1.55E+00	1.60E-01	4.84E+00
1.43E+04	7.00E-01	1.57E+01	1.35E+00	1.70E-01	3.97E+00
1.67E+04	6.00E-01	8.77E+00	1.37E+00	2.30E-01	2.97E+00
2.00E+04	5.00E-01	2.68E+00	3.09E+00	8.40E-01	1.84E+00
2.22E+04	4.50E-01	1.57E+00	5.26E+00	1.40E+00	1.88E+00

SOURCE: Reference 12

TABLE 3. GOLD (Au) (Continued)

ω(cm⁻¹)	λ(μm)	-ε1	ε2	n	k
8.33E+02	1.20E+01	6.24E+03	2.48E+03	1.54E+01	8.05E+01
1.00E+03	1.00E+01	4.42E+03	1.55E+03	1.15E+01	6.75E+01
1.25E+03	8.00E+00	2.92E+03	8.54E+02	7.82E+00	5.46E+01
1.67E+03	6.00E+00	1.72E+03	3.92E+02	4.70E+00	4.17E+01
2.00E+03	5.00E+00	1.23E+03	2.30E+02	3.27E+00	3.52E+01
2.50E+03	4.00E+00	7.74E+02	1.14E+02	2.04E+00	2.79E+01
3.33E+03	3.00E+00	4.40E+02	4.91E+01	1.17E+00	2.10E+01
4.00E+03	2.50E+00	2.99E+02	2.84E+01	8.20E-01	1.73E+01
5.00E+03	2.00E+00	1.93E+02	1.52E+01	5.46E-01	1.39E+01
6.67E+03	1.50E+00	1.08E+02	7.43E+00	3.57E-01	1.04E+01
1.00E+04	1.00E+00	4.50E+01	3.01E+00	2.24E-01	6.71E+00

SOURCE: Reference 16

ω(cm⁻¹)	λ(μm)	-ε1	ε2	n	k
9.09E+02	1.10E+01	3.31E+03	1.01E+03	8.71E+00	5.82E+01
1.00E+03	1.00E+01	2.80E+03	7.91E+02	7.41E+00	5.34E+01
1.11E+03	9.00E+00	2.32E+03	6.04E+02	6.21E+00	4.86E+01
1.25E+03	8.00E+00	1.87E+03	4.39E+02	5.05E+00	4.35E+01
1.43E+03	7.00E+00	1.45E+03	3.04E+02	3.97E+00	3.83E+01
1.67E+03	6.00E+00	1.08E+03	1.99E+02	3.01E+00	3.30E+01
2.00E+03	5.00E+00	7.62E+02	1.21E+02	2.19E+00	2.77E+01
2.50E+03	4.00E+00	4.91E+02	6.62E+01	1.49E+00	2.22E+01
3.33E+03	3.00E+00	2.78E+02	3.11E+01	9.30E-01	1.67E+01
5.00E+03	2.00E+00	1.25E+02	1.21E+01	5.40E-01	1.12E+01
1.00E+04	1.00E+00	3.10E+01	3.46E+00	3.10E-01	5.58E+00

SOURCE: Reference 17

TABLE 3. GOLD (Au) (Continued)

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
1.05E+03	9.50E+00	2.44E+03	1.10E+03	1.09E+01	5.06E+01
1.11E+03	9.00E+00	2.19E+03	9.58E+02	1.00E+01	4.79E+01
1.18E+03	8.50E+00	1.98E+03	8.86E+02	9.72E+00	4.56E+01
1.25E+03	8.00E+00	1.87E+03	6.95E+02	7.90E+00	4.40E+01
1.43E+03	7.00E+00	1.51E+03	5.22E+02	6.62E+00	3.94E+01
1.54E+03	6.50E+00	1.37E+03	4.10E+02	5.48E+00	3.74E+01
1.67E+03	6.00E+00	1.17E+03	3.25E+02	4.71E+00	3.45E+01
2.00E+03	5.00E+00	8.05E+02	1.54E+02	2.71E+00	2.85E+01
2.22E+03	4.50E+00	6.35E+02	1.15E+02	2.28E+00	2.53E+01
2.50E+03	4.00E+00	5.35E+02	8.72E+01	1.88E+00	2.32E+01
3.33E+03	3.00E+00	3.08E+02	4.40E+01	1.25E+00	1.76E+01
4.00E+03	2.50E+00	2.07E+02	1.99E+01	6.90E-01	1.44E+01

SOURCE: Reference 18

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
3.14E+01	3.18E+02	8.62E+04	6.23E+05	5.21E+02	5.98E+02
3.72E+01	2.69E+02	8.74E+04	5.37E+05	4.78E+02	5.62E+02
4.24E+01	2.36E+02	9.47E+04	4.81E+05	4.45E+02	5.41E+02
5.00E+01	2.00E+02	9.18E+04	4.00E+05	3.99E+02	5.01E+02
6.06E+01	1.65E+02	9.87E+04	3.37E+05	3.55E+02	4.74E+02
6.99E+01	1.43E+02	9.60E+04	2.82E+05	3.18E+02	4.44E+02
8.00E+01	1.25E+02	9.97E+04	2.47E+05	2.89E+02	4.28E+02
9.01E+01	1.11E+02	1.00E+05	2.15E+05	2.62E+02	4.11E+02
1.00E+02	1.00E+02	1.06E+05	1.93E+05	2.39E+02	4.04E+02
1.10E+02	9.09E+01	1.03E+05	1.68E+05	2.17E+02	3.88E+02
1.20E+02	8.33E+01	1.04E+05	1.49E+05	1.97E+02	3.78E+02
1.30E+02	7.69E+01	9.72E+04	1.30E+05	1.80E+02	3.60E+02
1.40E+02	7.14E+01	9.66E+04	1.14E+05	1.63E+02	3.51E+02
1.50E+02	6.67E+01	8.51E+04	1.00E+05	1.52E+02	3.29E+02

SOURCE: Reference 1

TABLE 3. GOLD (Au) (Continued)

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
8.07E+02	1.24E+01	6.79E+03	1.35E+03	8.17E+00	8.28E+01
1.21E+03	8.27E+00	3.07E+03	4.12E+02	3.71E+00	5.56E+01
1.61E+03	6.20E+00	1.74E+03	1.78E+02	2.13E+00	4.17E+01
2.02E+03	4.96E+00	1.11E+03	9.29E+01	1.39E+00	3.34E+01
2.42E+03	4.13E+00	7.73E+02	5.51E+01	9.90E-01	2.78E+01
2.82E+03	3.54E+00	5.67E+02	3.57E+01	7.50E-01	2.38E+01
3.23E+03	3.10E+00	4.34E+02	2.46E+01	5.90E-01	2.08E+01
3.63E+03	2.76E+00	3.42E+02	1.74E+01	4.70E-01	1.85E+01
4.03E+03	2.48E+00	2.76E+02	1.30E+01	3.90E-01	1.66E+01
4.44E+03	2.25E+00	2.27E+02	9.95E+00	3.30E-01	1.51E+01
4.84E+03	2.07E+00	1.90E+02	7.72E+00	2.80E-01	1.38E+01
5.24E+03	1.91E+00	1.61E+02	6.09E+00	2.40E-01	1.27E+01
5.65E+03	1.77E+00	1.38E+02	5.17E+00	2.20E-01	1.18E+01
6.05E+03	1.65E+00	1.19E+02	4.15E+00	1.90E-01	1.09E+01
6.45E+03	1.55E+00	1.04E+02	3.68E+00	1.80E-01	1.02E+01
6.86E+03	1.46E+00	9.16E+01	3.06E+00	1.60E-01	9.57E+00
7.26E+03	1.38E+00	8.12E+01	2.70E+00	1.50E-01	9.01E+00
7.66E+03	1.31E+00	7.21E+01	2.38E+00	1.40E-01	8.49E+00
8.07E+03	1.24E+00	6.45E+01	2.09E+00	1.30E-01	8.03E+00
1.21E+04	8.27E-01	2.48E+01	7.97E-01	8.00E-02	4.98E+00
1.61E+04	6.20E-01	9.97E+00	8.22E-01	1.30E-01	3.16E+00

SOURCE: Reference 5

TABLE 4. LEAD (Pb)

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
6.25E+00	1.60E+03	1.99E+03	4.43E+05	4.69E+02	4.71E+02
1.17E+01	8.57E+02	1.74E+03	2.21E+05	3.31E+02	3.34E+02
1.78E+01	5.63E+02	2.21E+03	1.64E+05	2.85E+02	2.89E+02
2.61E+01	3.83E+02	2.40E+03	1.17E+05	2.39E+02	2.44E+02
3.38E+01	2.96E+02	2.14E+03	8.49E+04	2.03E+02	2.09E+02
4.41E+01	2.27E+02	2.10E+03	6.44E+04	1.77E+02	1.82E+02
5.38E+01	1.86E+02	2.09E+03	5.27E+04	1.59E+02	1.66E+02
6.28E+01	1.59E+02	2.05E+03	4.47E+04	1.46E+02	1.53E+02
7.19E+01	1.39E+02	2.01E+03	3.87E+04	1.35E+02	1.43E+02
7.96E+01	1.26E+02	2.02E+03	3.50E+04	1.28E+02	1.36E+02
8.92E+01	1.12E+02	1.85E+03	2.98E+04	1.18E+02	1.26E+02
1.02E+02	9.80E+01	1.71E+03	2.51E+04	1.08E+02	1.16E+02
1.12E+02	8.96E+01	1.64E+03	2.24E+04	1.02E+02	1.10E+02
1.21E+02	8.25E+01	1.61E+03	2.05E+04	9.72E+01	1.05E+02

SOURCE: Reference 1

TABLE 4. LEAD (Pb) (Continued)

ω(cm⁻¹)	λ(μm)	-ε1	ε2	n	k
8.33E+02	1.20E+01	1.04E+03	1.99E+03	2.46E+01	4.05E+01
9.09E+02	1.10E+01	9.98E+02	1.82E+03	2.32E+01	3.92E+01
1.00E+03	1.00E+01	9.58E+02	1.57E+03	2.10E+01	3.74E+01
1.11E+03	9.00E+00	9.32E+02	1.34E+03	1.87E+01	3.58E+01
1.25E+03	8.00E+00	8.60E+02	1.10E+03	1.64E+01	3.36E+01
1.43E+03	7.00E+00	7.56E+02	8.71E+02	1.41E+01	3.09E+01
1.67E+03	6.00E+00	6.53E+02	6.58E+02	1.17E+01	2.81E+01
2.00E+03	5.00E+00	5.33E+02	4.48E+02	9.04E+00	2.48E+01
2.50E+03	4.00E+00	3.89E+02	2.74E+02	6.58E+00	2.08E+01
2.86E+03	3.50E+00	3.17E+02	2.01E+02	5.39E+00	1.86E+01
3.33E+03	3.00E+00	2.51E+02	1.40E+02	4.27E+00	1.64E+01
3.85E+03	2.60E+00	1.95E+02	9.94E+01	3.45E+00	1.44E+01
4.00E+03	2.50E+00	1.83E+02	8.95E+01	3.22E+00	1.39E+01
4.17E+03	2.40E+00	1.65E+02	8.00E+01	3.03E+00	1.32E+01
4.35E+03	2.30E+00	1.56E+02	7.27E+01	2.84E+00	1.28E+01
4.55E+03	2.20E+00	1.42E+02	6.42E+01	2.63E+00	1.22E+01
4.76E+03	2.10E+00	1.31E+02	5.78E+01	2.47E+00	1.17E+01
5.00E+03	2.00E+00	1.20E+02	5.20E+01	2.32E+00	1.12E+01
5.88E+03	1.70E+00	8.61E+01	3.58E+01	1.89E+00	9.47E+00
6.67E+03	1.50E+00	6.62E+01	2.72E+01	1.64E+00	8.30E+00
7.69E+03	1.30E+00	7.43E-01	5.19E+00	1.50E+00	1.73E+00
1.00E+04	1.00E+00	2.64E+01	1.47E+01	1.38E+00	5.32E+00
1.11E+04	9.00E-01	1.99E+01	1.31E+01	1.40E+00	4.68E+00
1.18E+04	8.50E-01	1.68E+01	1.25E+01	1.44E+00	4.35E+00
1.25E+04	8.00E-01	1.45E+01	1.23E+01	1.50E+00	4.09E+00
1.33E+04	7.50E-01	1.17E+01	1.21E+01	1.60E+00	3.78E+00
1.43E+04	7.00E-01	9.58E+00	1.27E+01	1.78E+00	3.57E+00
1.54E+04	6.50E-01	8.67E+00	1.34E+01	1.91E+00	3.51E+00
1.67E+04	6.00E-01	8.25E+00	1.32E+01	1.91E+00	3.45E+00
1.82E+04	5.50E-01	8.21E+00	1.24E+01	1.83E+00	3.40E+00
2.00E+04	5.00E-01	8.00E+00	1.12E+01	1.70E+00	3.30E+00
2.22E+04	4.50E-01	8.04E+00	9.16E+00	1.44E+00	3.18E+00

SOURCE: Reference 19

TABLE 5. SILVER (Ag)

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
1.67E+04	6.00E-01	1.54E+01	5.80E-01	7.40E-02	3.92E+00
1.74E+04	5.75E-01	1.39E+01	5.07E-01	6.80E-02	3.73E+00
1.82E+04	5.50E-01	1.20E+01	4.57E-01	6.60E-02	3.46E+00
1.90E+04	5.25E-01	1.08E+01	4.08E-01	6.20E-02	3.29E+00
2.00E+04	5.00E-01	9.30E+00	3.72E-01	6.10E-02	3.05E+00
2.11E+04	4.75E-01	8.01E+00	3.51E-01	6.20E-02	2.83E+00
2.22E+04	4.50E-01	6.81E+00	3.34E-01	6.40E-02	2.61E+00
2.35E+04	4.25E-01	5.19E+00	3.24E-01	7.10E-02	2.28E+00
2.50E+04	4.00E-01	4.16E+00	3.18E-01	7.80E-02	2.04E+00

SOURCE: Reference 34

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
3.13E+02	3.20E+01	4.44E+04	2.06E+04	4.78E+01	2.16E+02
3.33E+02	3.00E+01	3.98E+04	1.74E+04	4.26E+01	2.04E+02
3.57E+02	2.80E+01	3.55E+04	1.44E+04	3.76E+01	1.92E+02
3.85E+02	2.60E+01	3.10E+04	1.17E+04	3.28E+01	1.79E+02
4.17E+02	2.40E+01	2.71E+04	9.45E+03	2.83E+01	1.67E+02
4.55E+02	2.20E+01	2.31E+04	7.39E+03	2.40E+01	1.54E+02
5.00E+02	2.00E+01	1.95E+04	5.67E+03	2.01E+01	1.41E+02
5.56E+02	1.80E+01	1.59E+04	4.17E+03	1.64E+01	1.27E+02
6.25E+02	1.60E+01	1.28E+04	2.99E+03	1.31E+01	1.14E+02
7.14E+02	1.40E+01	9.90E+03	2.02E+03	1.01E+01	1.00E+02
8.33E+02	1.20E+01	7.34E+03	1.28E+03	7.46E+00	8.60E+01
1.00E+03	1.00E+01	5.14E+03	7.49E+02	5.21E+00	7.19E+01
1.25E+03	8.00E+00	3.32E+03	3.87E+02	3.35E+00	5.77E+01
1.43E+03	7.00E+00	2.55E+03	2.60E+02	2.57E+00	5.06E+01
1.67E+03	6.00E+00	1.88E+03	1.64E+02	1.89E+00	4.34E+01
2.00E+03	5.00E+00	1.31E+03	9.56E+01	1.32E+00	3.62E+01
2.50E+03	4.00E+00	8.34E+02	4.88E+01	8.44E-01	2.89E+01
3.33E+03	3.00E+00	4.71E+02	2.06E+01	4.74E-01	2.17E+01
5.00E+03	2.00E+00	2.10E+02	6.15E+00	2.12E-01	1.45E+01

SOURCE: Reference 7

TABLE 5. SILVER (Ag) (Continued)

ω(cm^{-1})	λ(μm)	$-\epsilon_1$	ϵ_2	n	k
1.05E+04	9.50E-01	4.30E+01	1.44E+00	1.10E-01	6.56E+00
1.11E+04	9.00E-01	3.87E+01	1.31E+00	1.05E-01	6.22E+00
1.18E+04	8.50E-01	3.42E+01	1.17E+00	1.00E-01	5.85E+00
1.25E+04	8.00E-01	2.97E+01	9.81E-01	9.00E-02	5.45E+00
1.33E+04	7.50E-01	2.55E+01	8.08E-01	8.00E-02	5.05E+00
1.43E+04	7.00E-01	2.13E+01	6.93E-01	7.50E-02	4.62E+00
1.54E+04	6.50E-01	1.76E+01	5.88E-01	7.00E-02	4.20E+00
1.67E+04	6.00E-01	1.41E+01	4.50E-01	6.00E-02	3.75E+00
1.82E+04	5.50E-01	1.10E+01	3.65E-01	5.50E-02	3.32E+00
2.00E+04	5.00E-01	8.23E+00	2.87E-01	5.00E-02	2.87E+00
2.22E+04	4.50E-01	5.55E+00	2.66E+00	5.50E-01	2.42E+00
2.50E+04	4.00E-01	3.72E+00	2.90E-01	7.50E-02	1.93E+00

SOURCE: Reference 12

ω(cm^{-1})	λ(μm)	$-\epsilon_1$	ϵ_2	n	k
8.07E+02	1.24E+01	8.05E+03	1.79E+03	9.91E+00	9.03E+01
1.61E+03	6.20E+00	2.08E+03	2.60E+02	2.84E+00	4.57E+01
2.42E+03	4.13E+00	9.29E+02	8.60E+01	1.41E+00	3.05E+01
3.23E+03	3.10E+00	5.23E+02	4.17E+01	9.10E-01	2.29E+01
4.03E+03	2.48E+00	3.35E+02	2.45E+01	6.70E-01	1.83E+01
8.07E+03	1.24E+00	8.15E+01	5.06E+00	2.80E-01	9.03E+00
1.21E+04	8.27E-01	3.35E+01	3.13E+00	2.70E-01	5.79E+00
1.61E+04	6.20E-01	1.74E+01	2.26E+00	2.70E-01	4.18E+00

SOURCE: Reference 15

TABLE 6. COBALT (Co)

ω(cm^{-1})	λ(μm)	$-\epsilon 1$	$\epsilon 2$	n	k
5.00E+02	2.00E+01	2.44E+03	1.57E+03	1.52E+01	5.17E+01
5.26E+02	1.90E+01	2.18E+03	1.46E+03	1.49E+01	4.90E+01
5.88E+02	1.70E+01	1.84E+03	1.22E+03	1.35E+01	4.50E+01
6.67E+02	1.50E+01	1.51E+03	9.07E+02	1.12E+01	4.05E+01
7.14E+02	1.40E+01	1.34E+03	7.75E+02	1.02E+01	3.80E+01
8.33E+02	1.20E+01	1.12E+03	6.25E+02	9.00E+00	3.47E+01
9.09E+02	1.10E+01	9.97E+02	5.28E+02	8.10E+00	3.26E+01
1.00E+03	1.00E+01	8.20E+02	4.19E+02	7.10E+00	2.95E+01
1.11E+03	9.00E+00	6.97E+02	3.57E+02	6.56E+00	2.72E+01
1.25E+03	8.00E+00	5.42E+02	2.78E+02	5.80E+00	2.40E+01
1.43E+03	7.00E+00	4.08E+02	2.26E+02	5.40E+00	2.09E+01
1.54E+03	6.50E+00	3.45E+02	2.01E+02	5.20E+00	1.93E+01
1.67E+03	6.00E+00	2.81E+02	1.75E+02	5.00E+00	1.75E+01
1.82E+03	5.50E+00	2.40E+02	1.54E+02	4.76E+00	1.62E+01
2.00E+03	5.00E+00	1.94E+02	1.38E+02	4.70E+00	1.47E+01
2.22E+03	4.50E+00	1.36E+02	1.20E+02	4.78E+00	1.26E+01
2.50E+03	4.00E+00	9.89E+01	1.03E+02	4.70E+00	1.10E+01
3.33E+03	3.00E+00	4.78E+01	8.26E+01	4.88E+00	8.46E+00
4.00E+03	2.50E+00	3.48E+01	7.96E+01	5.10E+00	7.80E+00

SOURCE: Reference 20

TABLE 6. COBALT (Co) (Continued)

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
5.16E+03	1.94E+00	4.57E+01	6.03E+01	3.87E+00	7.79E+00
6.21E+03	1.61E+00	3.97E+01	5.24E+01	3.61E+00	7.26E+00
7.18E+03	1.39E+00	3.41E+01	4.63E+01	3.42E+00	6.77E+00
8.23E+03	1.22E+00	2.98E+01	4.00E+01	3.17E+00	6.31E+00
9.19E+03	1.09E+00	2.59E+01	3.46E+01	2.94E+00	5.88E+00
1.02E+04	9.84E-01	2.25E+01	3.06E+01	2.78E+00	5.50E+00
1.12E+04	8.92E-01	1.96E+01	2.73E+01	2.65E+00	5.16E+00
1.22E+04	8.21E-01	1.74E+01	2.47E+01	2.53E+00	4.88E+00
1.32E+04	7.56E-01	1.58E+01	2.23E+01	2.40E+00	4.64E+00
1.42E+04	7.04E-01	1.45E+01	2.06E+01	2.31E+00	4.45E+00
1.52E+04	6.59E-01	1.32E+01	1.92E+01	2.25E+00	4.27E+00
1.62E+04	6.17E-01	1.21E+01	1.80E+01	2.19E+00	4.11E+00
1.72E+04	5.82E-01	1.11E+01	1.69E+01	2.13E+00	3.96E+00
1.82E+04	5.49E-01	1.04E+01	1.57E+01	2.05E+00	3.82E+00
1.92E+04	5.21E-01	9.66E+00	1.45E+01	1.97E+00	3.68E+00
2.02E+04	4.96E-01	9.07E+00	1.33E+01	1.88E+00	3.55E+00
2.12E+04	4.71E-01	8.35E+00	1.23E+01	1.81E+00	3.41E+00
2.22E+04	4.51E-01	7.73E+00	1.14E+01	1.74E+00	3.28E+00
2.32E+04	4.30E-01	7.26E+00	1.06E+01	1.67E+00	3.17E+00
2.42E+04	4.13E-01	6.71E+00	9.82E+00	1.61E+00	3.05E+00
2.52E+04	3.97E-01	6.12E+00	9.20E+00	1.57E+00	2.93E+00
2.62E+04	3.81E-01	5.61E+00	8.63E+00	1.53E+00	2.82E+00
2.72E+04	3.68E-01	5.09E+00	8.13E+00	1.50E+00	2.71E+00
2.82E+04	3.54E-01	4.59E+00	7.78E+00	1.49E+00	2.61E+00
2.92E+04	3.42E-01	4.16E+00	7.46E+00	1.48E+00	2.52E+00
3.02E+04	3.31E-01	3.82E+00	7.12E+00	1.46E+00	2.44E+00
3.12E+04	3.20E-01	3.51E+00	6.87E+00	1.45E+00	2.37E+00
3.22E+04	3.11E-01	3.26E+00	6.65E+00	1.44E+00	2.31E+00
3.32E+04	3.01E-01	2.99E+00	6.48E+00	1.44E+00	2.25E+00
3.42E+04	2.92E-01	2.72E+00	6.31E+00	1.44E+00	2.19E+00
3.52E+04	2.84E-01	2.51E+00	6.16E+00	1.44E+00	2.14E+00
3.62E+04	2.76E-01	2.29E+00	6.02E+00	1.44E+00	2.09E+00
3.72E+04	2.69E-01	2.09E+00	5.88E+00	1.44E+00	2.04E+00
3.82E+04	2.62E-01	1.97E+00	5.79E+00	1.44E+00	2.01E+00
3.92E+04	2.55E-01	1.78E+00	5.71E+00	1.45E+00	1.97E+00
4.02E+04	2.49E-01	1.62E+00	5.60E+00	1.45E+00	1.93E+00
4.12E+04	2.43E-01	1.52E+00	5.58E+00	1.46E+00	1.91E+00
4.22E+04	2.37E-01	1.41E+00	5.56E+00	1.47E+00	1.89E+00
4.32E+04	2.31E-01	1.34E+00	5.50E+00	1.47E+00	1.87E+00
4.42E+04	2.26E-01	1.36E+00	5.39E+00	1.45E+00	1.86E+00
4.52E+04	2.21E-01	1.38E+00	5.29E+00	1.43E+00	1.85E+00
4.62E+04	2.16E-01	1.40E+00	5.19E+00	1.41E+00	1.84E+00
4.72E+04	2.12E-01	1.41E+00	5.02E+00	1.38E+00	1.82E+00
4.82E+04	2.07E-01	1.32E+00	4.84E+00	1.36E+00	1.78E+00
4.92E+04	2.03E-01	1.32E+00	4.62E+00	1.32E+00	1.75E+00
5.02E+04	1.99E-01	1.26E+00	4.41E+00	1.29E+00	1.71E+00
5.12E+04	1.95E-01	1.20E+00	4.21E+00	1.26E+00	1.67E+00
5.22E+04	1.92E-01	1.19E+00	3.94E+00	1.21E+00	1.63E+00
5.32E+04	1.88E-01	1.18E+00	3.69E+00	1.16E+00	1.59E+00

SOURCE: Reference 21

TABLE 6. COBALT (Co) (Continued)

ω(cm⁻¹)	λ(μm)	-ε1	ε2	n	k
8.07E+02	1.24E+01	1.39E+03	5.08E+02	6.71E+00	3.79E+01
1.05E+03	9.54E+00	9.05E+02	3.29E+02	5.38E+00	3.06E+01
1.21E+03	8.27E+00	6.27E+02	2.37E+02	4.66E+00	2.55E+01
1.61E+03	6.20E+00	3.40E+02	1.33E+02	3.55E+00	1.88E+01
2.02E+03	4.96E+00	1.97E+02	1.16E+02	3.98E+00	1.46E+01
2.42E+03	4.13E+00	1.32E+02	9.83E+01	4.04E+00	1.22E+01
2.82E+03	3.54E+00	9.03E+01	8.68E+01	4.18E+00	1.04E+01
3.23E+03	3.10E+00	6.54E+01	7.74E+01	4.24E+00	9.13E+00
3.63E+03	2.76E+00	4.80E+01	6.89E+01	4.24E+00	8.12E+00
4.03E+03	2.48E+00	3.22E+01	6.34E+01	4.41E+00	7.19E+00
4.84E+03	2.07E+00	1.35E+01	6.02E+01	4.91E+00	6.13E+00
5.65E+03	1.77E+00	6.76E+00	6.13E+01	5.24E+00	5.85E+00
6.45E+03	1.55E+00	7.96E+00	6.09E+01	5.17E+00	5.89E+00
7.26E+03	1.38E+00	1.10E+01	5.88E+01	4.94E+00	5.95E+00
8.07E+03	1.24E+00	1.44E+01	5.23E+01	4.46E+00	5.86E+00
9.68E+03	1.03E+00	1.42E+01	4.08E+01	3.81E+00	5.36E+00
1.21E+04	8.27E-01	1.50E+01	3.08E+01	3.10E+00	4.96E+00
1.61E+04	6.20E-01	1.11E+01	1.77E+01	2.21E+00	4.00E+00

SOURCE: Reference 22

TABLE 7. IRON (Fe)

ω(cm^{-1})	λ(μm)	$-\epsilon_1$	ϵ_2	n	k
8.07E+02	1.24E+01	1.05E+03	4.24E+02	6.41E+00	3.31E+01
1.05E+03	9.54E+00	6.79E+02	3.36E+02	6.26E+00	2.68E+01
1.21E+03	8.27E+00	4.82E+02	2.86E+02	6.26E+00	2.28E+01
1.37E+03	7.29E+00	3.82E+02	2.58E+02	6.28E+00	2.05E+01
1.61E+03	6.20E+00	3.19E+02	1.34E+02	3.68E+00	1.82E+01
1.77E+03	5.64E+00	2.16E+02	1.48E+02	4.80E+00	1.55E+01
1.94E+03	5.17E+00	1.88E+02	1.45E+02	4.96E+00	1.46E+01
2.10E+03	4.77E+00	1.62E+02	1.36E+02	4.98E+00	1.37E+01
2.26E+03	4.43E+00	1.43E+02	1.23E+02	4.78E+00	1.29E+01
2.42E+03	4.13E+00	1.21E+02	1.17E+02	4.87E+00	1.21E+01
2.58E+03	3.87E+00	1.11E+02	1.09E+02	4.73E+00	1.15E+01
2.74E+03	3.65E+00	9.69E+01	1.03E+02	4.70E+00	1.09E+01
2.90E+03	3.44E+00	8.71E+01	9.77E+01	4.68E+00	1.04E+01
3.06E+03	3.26E+00	8.00E+01	9.32E+01	4.63E+00	1.01E+01
3.23E+03	3.10E+00	7.55E+01	8.62E+01	4.42E+00	9.75E+00
4.03E+03	2.48E+00	4.72E+01	6.64E+01	4.14E+00	8.02E+00
4.84E+03	2.07E+00	3.29E+01	5.46E+01	3.93E+00	6.95E+00
5.65E+03	1.77E+00	2.38E+01	4.66E+01	3.78E+00	6.17E+00
6.45E+03	1.55E+00	1.80E+01	4.09E+01	3.65E+00	5.60E+00
7.26E+03	1.38E+00	1.42E+01	3.63E+01	3.52E+00	5.16E+00
8.07E+03	1.24E+00	1.12E+01	3.29E+01	3.43E+00	4.79E+00
8.87E+03	1.13E+00	1.03E+01	3.08E+01	3.33E+00	4.62E+00
9.68E+03	1.03E+00	7.65E+00	2.76E+01	3.24E+00	4.26E+00
1.05E+04	9.54E-01	6.58E+00	2.57E+01	3.16E+00	4.07E+00
1.13E+04	8.86E-01	5.24E+00	2.41E+01	3.12E+00	3.87E+00
1.21E+04	8.27E-01	4.91E+00	2.30E+01	3.05E+00	3.77E+00
1.29E+04	7.75E-01	3.96E+00	2.16E+01	3.00E+00	3.60E+00
1.37E+04	7.29E-01	3.51E+00	2.10E+01	2.98E+00	3.52E+00
1.45E+04	6.89E-01	3.45E+00	2.02E+01	2.92E+00	3.46E+00
1.53E+04	6.53E-01	3.00E+00	1.95E+01	2.89E+00	3.37E+00
1.61E+04	6.20E-01	3.11E+00	1.92E+01	2.86E+00	3.36E+00

SOURCE: Reference 22

TABLE 7. IRON (Fe) (Continued)

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
5.26E+02	1.90E+01	1.92E+03	1.09E+03	1.20E+01	4.54E+01
5.56E+02	1.80E+01	1.58E+03	9.52E+02	1.15E+01	4.14E+01
5.88E+02	1.70E+01	1.41E+03	8.70E+02	1.11E+01	3.92E+01
6.25E+02	1.60E+01	1.27E+03	8.04E+02	1.08E+01	3.72E+01
6.67E+02	1.50E+01	1.15E+03	7.62E+02	1.07E+01	3.56E+01
7.14E+02	1.40E+01	1.06E+03	7.18E+02	1.05E+01	3.42E+01
7.69E+02	1.30E+01	9.52E+02	6.63E+02	1.02E+01	3.25E+01
8.33E+02	1.20E+01	8.43E+02	5.47E+02	9.00E+00	3.04E+01
9.09E+02	1.10E+01	7.20E+02	4.48E+02	8.00E+00	2.80E+01
1.00E+03	1.00E+01	6.06E+02	3.58E+02	7.00E+00	2.56E+01
1.11E+03	9.00E+00	4.67E+02	2.98E+02	6.60E+00	2.26E+01
1.25E+03	8.00E+00	3.46E+02	2.56E+02	6.50E+00	1.97E+01
1.43E+03	7.00E+00	2.68E+02	1.94E+02	5.60E+00	1.73E+01
1.67E+03	6.00E+00	1.89E+02	1.35E+02	4.65E+00	1.45E+01
2.00E+03	5.00E+00	1.39E+02	1.04E+02	4.15E+00	1.25E+01
2.50E+03	4.00E+00	8.36E+01	8.10E+01	4.05E+00	1.00E+01
3.33E+03	3.00E+00	4.72E+01	6.16E+01	3.90E+00	7.90E+00
4.17E+03	2.40E+00	4.01E+01	4.37E+01	3.10E+00	7.05E+00
5.00E+03	2.00E+00	2.98E+01	3.97E+01	3.15E+00	6.30E+00
6.67E+03	1.50E+00	2.00E+01	3.02E+01	2.85E+00	5.30E+00
1.00E+04	1.00E+00	1.51E+01	2.08E+01	2.30E+00	4.52E+00

SOURCE: Reference 23

TABLE 8. NICKEL (Ni)

ω(cm⁻¹)	λ(μm)	-ε1	ε2	n	k
8.07E+02	1.24E+01	2.01E+03	8.74E+02	9.54E+00	4.58E+01
8.87E+02	1.13E+01	1.68E+03	6.79E+02	8.12E+00	4.18E+01
9.03E+03	1.11E+00	1.41E+03	5.44E+02	7.11E+00	3.83E+01
1.05E+03	9.54E+00	1.21E+03	4.55E+02	6.44E+00	3.53E+01
1.13E+03	8.86E+00	1.04E+03	3.82E+02	5.83E+00	3.28E+01
1.21E+03	8.27E+00	9.04E+02	3.33E+02	5.45E+00	3.06E+01
1.29E+03	7.75E+00	7.95E+02	2.86E+02	5.00E+00	2.86E+01
1.37E+03	7.29E+00	6.98E+02	2.51E+02	4.68E+00	2.68E+01
1.45E+03	6.89E+00	6.17E+02	2.25E+02	4.45E+00	2.52E+01
1.53E+03	6.53E+00	5.48E+02	2.05E+02	4.30E+00	2.38E+01
1.61E+03	6.20E+00	4.88E+02	1.85E+02	4.12E+00	2.25E+01
1.69E+03	5.90E+00	4.35E+02	1.76E+02	4.13E+00	2.13E+01
1.77E+03	5.64E+00	3.92E+02	1.66E+02	4.11E+00	2.02E+01
1.86E+03	5.39E+00	3.54E+02	1.60E+02	4.14E+00	1.93E+01
1.94E+03	5.17E+00	3.22E+02	1.53E+02	4.16E+00	1.84E+01
2.02E+03	4.96E+00	2.95E+02	1.50E+02	4.25E+00	1.77E+01
2.10E+03	4.77E+00	2.73E+02	1.46E+02	4.29E+00	1.71E+01
2.18E+03	4.59E+00	2.54E+02	1.42E+02	4.30E+00	1.65E+01
2.26E+03	4.43E+00	2.37E+02	1.38E+02	4.30E+00	1.60E+01
2.34E+03	4.28E+00	2.22E+02	1.32E+02	4.26E+00	1.55E+01
2.42E+03	4.13E+00	2.09E+02	1.26E+02	4.19E+00	1.51E+01
2.66E+03	3.76E+00	1.73E+02	1.13E+02	4.10E+00	1.38E+01
2.82E+03	3.54E+00	1.54E+02	1.05E+02	4.03E+00	1.31E+01
2.98E+03	3.35E+00	1.38E+02	9.84E+01	3.97E+00	1.24E+01
3.15E+03	3.18E+00	1.23E+02	9.12E+01	3.88E+00	1.18E+01
3.23E+03	3.10E+00	1.16E+02	8.78E+01	3.84E+00	1.14E+01
3.63E+03	2.76E+00	8.62E+01	8.56E+01	4.20E+00	1.02E+01
4.03E+03	2.48E+00	7.67E+01	7.77E+01	4.03E+00	9.64E+00
4.44E+03	2.25E+00	6.44E+01	6.96E+01	3.90E+00	8.92E+00
4.84E+03	2.07E+00	5.50E+01	6.41E+01	3.84E+00	8.35E+00
5.24E+03	1.91E+00	4.91E+01	5.84E+01	3.69E+00	7.92E+00
5.65E+03	1.77E+00	4.31E+01	5.37E+01	3.59E+00	7.48E+00
6.05E+03	1.65E+00	3.87E+01	4.98E+01	3.49E+00	7.13E+00
6.45E+03	1.55E+00	3.51E+01	4.61E+01	3.38E+00	6.82E+00
6.86E+03	1.46E+00	3.17E+01	4.26E+01	3.27E+00	6.51E+00
7.26E+03	1.38E+00	2.87E+01	3.96E+01	3.18E+00	6.23E+00
7.66E+03	1.31E+00	2.61E+01	3.72E+01	3.11E+00	5.98E+00
8.07E+03	1.24E+00	2.36E+01	3.51E+01	3.06E+00	5.74E+00
8.47E+03	1.18E+00	2.17E+01	3.34E+01	3.01E+00	5.55E+00
8.87E+03	1.13E+00	2.01E+01	3.20E+01	2.97E+00	5.38E+00
9.28E+03	1.08E+00	1.90E+01	3.05E+01	2.91E+00	5.24E+00
9.68E+03	1.03E+00	1.79E+01	2.91E+01	2.85E+00	5.10E+00
1.01E+04	9.92E-01	1.69E+01	2.78E+01	2.80E+00	4.97E+00
1.05E+04	9.54E-01	1.60E+01	2.66E+01	2.74E+00	4.85E+00
1.09E+04	9.18E-01	1.51E+01	2.54E+01	2.69E+00	4.73E+00
1.13E+04	8.86E-01	1.44E+01	2.45E+01	2.65E+00	4.63E+00
1.17E+04	8.55E-01	1.40E+01	2.36E+01	2.59E+00	4.55E+00
1.21E+04	8.27E-01	1.36E+01	2.26E+01	2.53E+00	4.47E+00
1.25E+04	8.00E-01	1.30E+01	2.17E+01	2.48E+00	4.38E+00
1.29E+04	7.75E-01	1.27E+01	2.09E+01	2.43E+00	4.31E+00

SOURCE: Reference 24

TABLE 8. NICKEL (Ni) (Continued)

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
5.16E+03	1.94E+00	7.06E+01	6.31E+01	3.47E+00	9.09E+00
6.21E+03	1.61E+00	5.35E+01	5.00E+01	3.14E+00	7.96E+00
7.18E+03	1.39E+00	4.14E+01	4.19E+01	2.96E+00	7.08E+00
8.23E+03	1.22E+00	3.36E+01	3.59E+01	2.79E+00	6.43E+00
9.19E+03	1.09E+00	2.81E+01	3.14E+01	2.65E+00	5.93E+00
1.02E+04	9.84E-01	2.47E+01	2.75E+01	2.48E+00	5.55E+00
1.12E+04	8.92E-01	2.16E+01	2.51E+01	2.40E+00	5.23E+00
1.22E+04	8.21E-01	1.96E+01	2.25E+01	2.26E+00	4.97E+00
1.32E+04	7.56E-01	1.78E+01	2.01E+01	2.13E+00	4.73E+00
1.42E+04	7.04E-01	1.60E+01	1.85E+01	2.06E+00	4.50E+00
1.52E+04	6.59E-01	1.42E+01	1.70E+01	1.99E+00	4.26E+00
1.62E+04	6.17E-01	1.22E+01	1.60E+01	1.99E+00	4.02E+00
1.72E+04	5.82E-01	1.06E+01	1.49E+01	1.96E+00	3.80E+00
1.82E+04	5.49E-01	9.35E+00	1.39E+01	1.92E+00	3.61E+00
1.92E+04	5.21E-01	8.27E+00	1.27E+01	1.85E+00	3.42E+00
2.02E+04	4.96E-01	7.25E+00	1.18E+01	1.82E+00	3.25E+00

SOURCE: Reference 21

TABLE 9. PALLADIUM (Pd)

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
8.07E+02	1.24E+01	2.92E+03	4.47E+02	4.13E+00	5.42E+01
8.87E+02	1.13E+01	2.41E+03	3.79E+02	3.85E+00	4.92E+01
9.68E+02	1.03E+01	2.02E+03	3.25E+02	3.60E+00	4.51E+01
1.05E+03	9.54E+00	1.71E+03	2.79E+02	3.36E+00	4.15E+01
1.13E+03	8.86E+00	1.47E+03	2.55E+02	3.31E+00	3.85E+01
1.21E+03	8.27E+00	1.27E+03	2.24E+02	3.13E+00	3.58E+01
1.61E+03	6.20E+00	6.98E+02	1.63E+02	3.07E+00	2.66E+01
2.42E+03	4.13E+00	2.86E+02	1.23E+02	3.56E+00	1.73E+01
3.23E+03	3.10E+00	1.58E+02	1.13E+02	4.27E+00	1.33E+01
4.03E+03	2.48E+00	1.14E+02	9.38E+01	4.10E+00	1.14E+01
4.84E+03	2.07E+00	8.48E+01	7.57E+01	3.80E+00	9.96E+00
6.45E+03	1.55E+00	5.37E+01	5.40E+01	3.35E+00	8.06E+00
8.07E+03	1.24E+00	3.85E+01	4.12E+01	2.99E+00	6.89E+00
1.21E+04	8.27E-01	2.25E+01	2.27E+01	2.17E+00	5.22E+00
1.61E+04	6.20E-01	1.44E+01	1.46E+01	1.75E+00	4.18E+00

SOURCE: Reference 25

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
5.56E+02	1.80E+01	7.70E+02	6.84E+02	1.14E+01	3.00E+01
6.25E+02	1.60E+01	6.49E+02	5.69E+02	1.04E+01	2.75E+01
7.14E+02	1.40E+01	5.64E+02	4.74E+02	9.30E+00	2.55E+01
8.33E+02	1.20E+01	4.91E+02	3.67E+02	7.80E+00	2.35E+01
9.09E+02	1.10E+01	4.59E+02	3.11E+02	6.90E+00	2.25E+01
1.00E+03	1.00E+01	4.04E+02	2.56E+02	6.10E+00	2.10E+01
1.11E+03	9.00E+00	3.37E+02	1.84E+02	4.85E+00	1.90E+01
1.25E+03	8.00E+00	2.69E+02	1.53E+02	4.50E+00	1.70E+01
1.43E+03	7.00E+00	2.22E+02	1.33E+02	4.30E+00	1.55E+01
1.67E+03	6.00E+00	1.59E+02	8.32E+01	3.20E+00	1.30E+01
2.00E+03	5.00E+00	1.03E+02	5.67E+01	2.70E+00	1.05E+01
2.50E+03	4.00E+00	5.68E+01	3.45E+01	2.20E+00	7.85E+00
3.33E+03	3.00E+00	2.61E+01	2.58E+01	2.30E+00	5.60E+00

SOURCE: Reference 26

TABLE 9. PALLADIUM (Pd) (Continued)

ω(cm⁻¹)	λ(μm)	-ε1	ε2	n	k
5.16E+03	1.94E+00	8.67E+01	6.61E+01	3.34E+00	9.89E+00
6.21E+03	1.61E+00	6.47E+01	5.17E+01	3.01E+00	8.59E+00
7.18E+03	1.39E+00	5.07E+01	4.28E+01	2.80E+00	7.65E+00
8.23E+03	1.22E+00	4.05E+01	3.67E+01	2.66E+00	6.90E+00
9.19E+03	1.09E+00	3.37E+01	3.19E+01	2.52E+00	6.33E+00
1.02E+04	9.84E-01	2.92E+01	2.76E+01	2.34E+00	5.89E+00
1.12E+04	8.92E-01	2.53E+01	2.45E+01	2.23E+00	5.50E+00
1.22E+04	8.21E-01	2.27E+01	2.14E+01	2.06E+00	5.19E+00
1.32E+04	7.56E-01	2.01E+01	1.91E+01	1.95E+00	4.89E+00
1.42E+04	7.04E-01	1.82E+01	1.73E+01	1.86E+00	4.65E+00
1.52E+04	6.59E-01	1.63E+01	1.59E+01	1.80E+00	4.42E+00
1.62E+04	6.17E-01	1.47E+01	1.47E+01	1.75E+00	4.21E+00
1.72E+04	5.82E-01	1.33E+01	1.35E+01	1.68E+00	4.02E+00
1.82E+04	5.49E-01	1.21E+01	1.26E+01	1.64E+00	3.84E+00
1.92E+04	5.21E-01	1.11E+01	1.16E+01	1.57E+00	3.68E+00
2.02E+04	4.96E-01	1.02E+01	1.08E+01	1.52E+00	3.54E+00
2.12E+04	4.71E-01	9.36E+00	9.90E+00	1.46E+00	3.39E+00
2.22E+04	4.51E-01	8.64E+00	9.19E+00	1.41E+00	3.26E+00
2.32E+04	4.30E-01	7.98E+00	8.60E+00	1.37E+00	3.14E+00
2.42E+04	4.13E-01	7.41E+00	8.06E+00	1.33E+00	3.03E+00
2.52E+04	3.97E-01	6.89E+00	7.62E+00	1.30E+00	2.93E+00
2.62E+04	3.81E-01	6.42E+00	7.13E+00	1.26E+00	2.83E+00
2.72E+04	3.68E-01	5.97E+00	6.80E+00	1.24E+00	2.74E+00
2.82E+04	3.54E-01	5.51E+00	6.52E+00	1.23E+00	2.65E+00
2.92E+04	3.42E-01	5.12E+00	6.27E+00	1.22E+00	2.57E+00
3.02E+04	3.31E-01	4.81E+00	6.00E+00	1.20E+00	2.50E+00
3.12E+04	3.20E-01	4.39E+00	5.86E+00	1.21E+00	2.42E+00
3.22E+04	3.11E-01	4.06E+00	5.69E+00	1.21E+00	2.35E+00
3.32E+04	3.01E-01	3.80E+00	5.50E+00	1.20E+00	2.29E+00
3.42E+04	2.92E-01	3.58E+00	5.26E+00	1.18E+00	2.23E+00
3.52E+04	2.84E-01	3.36E+00	5.14E+00	1.18E+00	2.18E+00
3.62E+04	2.76E-01	3.12E+00	5.07E+00	1.19E+00	2.13E+00
3.72E+04	2.69E-01	3.06E+00	4.87E+00	1.16E+00	2.10E+00
3.82E+04	2.62E-01	3.01E+00	4.68E+00	1.13E+00	2.07E+00
3.92E+04	2.55E-01	2.89E+00	4.51E+00	1.11E+00	2.03E+00
4.02E+04	2.49E-01	2.79E+00	4.30E+00	1.08E+00	1.99E+00
4.12E+04	2.43E-01	2.72E+00	4.06E+00	1.04E+00	1.95E+00
4.22E+04	2.37E-01	2.65E+00	3.82E+00	1.00E+00	1.91E+00
4.32E+04	2.31E-01	2.52E+00	3.61E+00	9.70E-01	1.86E+00
4.42E+04	2.26E-01	2.39E+00	3.40E+00	9.40E-01	1.81E+00
4.52E+04	2.21E-01	2.25E+00	3.24E+00	9.20E-01	1.76E+00
4.62E+04	2.16E-01	2.06E+00	3.09E+00	9.10E-01	1.70E+00
4.72E+04	2.12E-01	1.93E+00	2.94E+00	8.90E-01	1.65E+00
4.82E+04	2.07E-01	1.80E+00	2.78E+00	8.70E-01	1.60E+00

SOURCE: Reference 21

TABLE 10. PLATINUM (Pt)

ω(cm^{-1})	λ(μm)	$-\epsilon 1$	$\epsilon 2$	n	k
8.07E+02	1.24E+01	1.83E+03	1.18E+03	1.32E+01	4.47E+01
1.05E+03	9.54E+00	1.25E+03	7.28E+02	9.91E+00	3.67E+01
1.21E+03	8.27E+00	9.04E+02	5.10E+02	8.18E+00	3.12E+01
1.37E+03	7.29E+00	6.92E+02	3.68E+02	6.78E+00	2.72E+01
1.61E+03	6.20E+00	5.39E+02	2.83E+02	5.90E+00	2.40E+01
2.42E+03	4.13E+00	2.46E+02	1.27E+02	3.92E+00	1.62E+01
3.23E+03	3.10E+00	1.22E+02	6.40E+01	2.81E+00	1.14E+01
4.03E+03	2.48E+00	4.42E+01	6.03E+01	3.91E+00	7.71E+00
4.84E+03	2.07E+00	1.92E+01	6.93E+01	5.13E+00	6.75E+00
5.65E+03	1.77E+00	1.40E+01	7.80E+01	5.71E+00	6.83E+00
6.45E+03	1.55E+00	2.14E+01	7.48E+01	5.31E+00	7.04E+00
8.07E+03	1.24E+00	2.58E+01	5.63E+01	4.25E+00	6.62E+00
1.21E+04	8.27E-01	1.72E+01	2.96E+01	2.92E+00	5.07E+00
1.61E+04	6.20E-01	1.13E+01	1.87E+01	2.30E+00	4.07E+00

SOURCE: Reference 27

TABLE 10. PLATINUM (Pt) (Continued)

ω(cm^{-1})	λ(μm)	$-\epsilon 1$	$\epsilon 2$	n	k
8.06E+02	1.24E+01	1.62E+03	9.28E+02	1.11E+01	4.18E+01
1.20E+03	8.30E+00	8.02E+02	4.16E+02	7.12E+00	2.92E+01
1.61E+03	6.20E+00	4.75E+02	2.30E+02	5.14E+00	2.24E+01
2.42E+03	4.13E+00	2.17E+02	1.02E+02	3.39E+00	1.51E+01
2.82E+03	3.54E+00	1.56E+02	7.19E+01	2.81E+00	1.28E+01
3.23E+03	3.10E+00	1.08E+02	5.24E+01	2.45E+00	1.07E+01
3.62E+03	2.76E+00	6.93E+01	4.77E+01	2.72E+00	8.76E+00
4.03E+03	2.48E+00	4.33E+01	5.47E+01	3.64E+00	7.52E+00
4.44E+03	2.25E+00	3.09E+01	5.59E+01	4.06E+00	6.88E+00
4.83E+03	2.07E+00	2.21E+01	6.01E+01	4.58E+00	6.56E+00
5.24E+03	1.91E+00	1.89E+01	6.26E+01	4.82E+00	6.49E+00
5.65E+03	1.77E+00	1.86E+01	6.35E+01	4.88E+00	6.51E+00
6.06E+03	1.65E+00	2.00E+01	6.32E+01	4.81E+00	6.57E+00
6.45E+03	1.55E+00	2.18E+01	6.11E+01	4.64E+00	6.58E+00
6.85E+03	1.46E+00	2.37E+01	5.74E+01	4.38E+00	6.55E+00
7.25E+03	1.38E+00	2.47E+01	5.28E+01	4.10E+00	6.44E+00
8.06E+03	1.24E+00	2.40E+01	4.49E+01	3.67E+00	6.12E+00
8.85E+03	1.13E+00	2.22E+01	3.87E+01	3.35E+00	5.78E+00
9.71E+03	1.03E+00	2.04E+01	3.35E+01	3.07E+00	5.46E+00
1.05E+04	9.50E-01	1.85E+01	2.96E+01	2.86E+00	5.17E+00
1.12E+04	8.90E-01	1.68E+01	2.63E+01	2.68E+00	4.90E+00
1.20E+04	8.30E-01	1.55E+01	2.35E+01	2.52E+00	4.67E+00
1.30E+04	7.70E-01	1.41E+01	2.13E+01	2.39E+00	4.45E+00
1.37E+04	7.30E-01	1.30E+01	1.93E+01	2.27E+00	4.26E+00
1.45E+04	6.90E-01	1.19E+01	1.77E+01	2.17E+00	4.08E+00
1.49E+04	6.70E-01	1.15E+01	1.70E+01	2.12E+00	4.00E+00
1.54E+04	6.50E-01	1.11E+01	1.64E+01	2.09E+00	3.93E+00
1.56E+04	6.40E-01	1.11E+01	1.57E+01	2.02E+00	3.89E+00
1.61E+04	6.20E-01	1.06E+01	1.49E+01	1.96E+00	3.80E+00

SOURCE: Reference 28

TABLE 11. TITANIUM (Ti)

ω(cm⁻¹)	λ(μm)	-ε1	ε2	n	k
5.00E+02	2.00E+01	8.43E+02	1.17E+03	1.73E+01	3.38E+01
5.26E+02	1.90E+01	6.85E+02	1.04E+03	1.68E+01	3.11E+01
5.56E+02	1.80E+01	6.54E+02	8.82E+02	1.49E+01	2.96E+01
5.88E+02	1.70E+01	5.96E+02	7.67E+02	1.37E+01	2.80E+01
6.25E+02	1.60E+01	5.65E+02	7.05E+02	1.30E+01	2.71E+01
6.67E+02	1.50E+01	5.11E+02	6.14E+02	1.20E+01	2.56E+01
7.14E+02	1.40E+01	4.74E+02	5.25E+02	1.08E+01	2.43E+01
8.33E+02	1.20E+01	3.36E+02	3.77E+02	9.20E+00	2.05E+01
9.09E+02	1.10E+01	3.24E+02	3.38E+02	8.50E+00	1.99E+01
1.00E+03	1.00E+01	2.81E+02	2.90E+02	7.85E+00	1.85E+01
1.11E+03	9.00E+00	2.22E+02	2.42E+02	7.30E+00	1.66E+01
1.18E+03	8.50E+00	2.11E+02	2.24E+02	6.96E+00	1.61E+01
1.25E+03	8.00E+00	1.76E+02	1.94E+02	6.56E+00	1.48E+01
1.33E+03	7.50E+00	1.53E+02	1.75E+02	6.31E+00	1.39E+01
1.43E+03	7.00E+00	1.38E+02	1.58E+02	5.99E+00	1.32E+01
1.54E+03	6.50E+00	1.17E+02	1.37E+02	5.63E+00	1.22E+01
1.67E+03	6.00E+00	9.87E+01	1.22E+02	5.38E+00	1.13E+01
1.82E+03	5.50E+00	8.04E+01	1.04E+02	5.07E+00	1.03E+01
2.00E+03	5.00E+00	6.06E+01	8.94E+01	4.87E+00	9.18E+00
2.22E+03	4.50E+00	4.32E+01	7.51E+01	4.66E+00	8.06E+00
2.50E+03	4.00E+00	3.11E+01	6.78E+01	4.66E+00	7.27E+00
2.86E+03	3.50E+00	2.25E+01	6.00E+01	4.56E+00	6.58E+00
3.33E+03	3.00E+00	1.31E+01	5.33E+01	4.57E+00	5.83E+00
4.00E+03	2.50E+00	8.17E+00	4.93E+01	4.57E+00	5.39E+00

SOURCE: Reference 20

ω(cm⁻¹)	λ(μm)	-ε1	ε2	n	k
8.07E+02	1.24E+01	5.21E+02	2.35E+02	5.03E+00	2.34E+01
9.68E+02	1.03E+01	3.76E+02	1.54E+02	3.90E+00	1.98E+01
1.05E+03	9.54E+00	3.20E+02	1.27E+02	3.49E+00	1.82E+01
1.21E+03	8.27E+00	2.38E+02	9.43E+01	3.00E+00	1.57E+01
1.61E+03	6.20E+00	1.24E+02	4.81E+01	2.12E+00	1.13E+01
1.69E+03	5.90E+00	1.08E+02	4.33E+01	2.04E+00	1.06E+01

SOURCE: Reference 29

TABLE 11. TITANIUM (Ti) (Continued)

$\omega(cm^{-1})$	$\lambda(\mu m)$	$-\epsilon 1$	$\epsilon 2$	n	k
5.16E+03	1.94E+00	1.46E+01	3.64E+01	3.51E+00	5.19E+00
6.21E+03	1.61E+00	8.47E+00	3.47E+01	3.69E+00	4.70E+00
7.18E+03	1.39E+00	5.63E+00	3.21E+01	3.67E+00	4.37E+00
8.23E+03	1.22E+00	4.12E+00	3.00E+01	3.62E+00	4.15E+00
9.19E+03	1.09E+00	3.91E+00	2.81E+01	3.50E+00	4.02E+00
1.02E+04	9.84E-01	4.54E+00	2.66E+01	3.35E+00	3.97E+00
1.12E+04	8.92E-01	4.86E+00	2.61E+01	3.29E+00	3.96E+00
1.22E+04	8.21E-01	5.78E+00	2.57E+01	3.21E+00	4.01E+00

SOURCE: Reference 21

$\omega(cm^{-1})$	$\lambda(\mu m)$	$-\epsilon 1$	$\epsilon 2$	n	k
2.50E+03	4.00E+00	3.17E+01	6.79E+01	4.65E+00	7.30E+00
2.86E+03	3.50E+00	2.29E+01	6.01E+01	4.55E+00	6.60E+00
3.33E+03	3.00E+00	1.44E+01	5.21E+01	4.45E+00	5.85E+00
4.00E+03	2.50E+00	8.20E+00	4.62E+01	4.40E+00	5.25E+00
4.17E+03	2.40E+00	9.17E+00	4.61E+01	4.35E+00	5.30E+00
4.35E+03	2.30E+00	6.94E+00	4.25E+01	4.25E+00	5.00E+00
4.55E+03	2.20E+00	7.36E+00	4.20E+01	4.20E+00	5.00E+00
5.00E+03	2.00E+00	7.12E+00	3.93E+01	4.05E+00	4.85E+00
5.56E+03	1.80E+00	4.76E+00	3.73E+01	4.05E+00	4.60E+00
5.88E+03	1.70E+00	5.81E+00	3.42E+01	3.80E+00	4.50E+00
6.25E+03	1.60E+00	5.36E+00	3.38E+01	3.80E+00	4.45E+00
6.45E+03	1.55E+00	6.56E+00	3.33E+01	3.70E+00	4.50E+00
6.67E+03	1.50E+00	4.48E+00	3.31E+01	3.80E+00	4.35E+00
6.90E+03	1.45E+00	4.37E+00	3.15E+01	3.70E+00	4.25E+00
7.14E+03	1.40E+00	5.04E+00	2.98E+01	3.55E+00	4.20E+00
7.41E+03	1.35E+00	3.75E+00	2.80E+01	3.50E+00	4.00E+00
7.69E+03	1.30E+00	4.84E+00	2.75E+01	3.40E+00	4.05E+00
8.00E+03	1.25E+00	8.47E+00	2.90E+01	3.30E+00	4.40E+00
8.33E+03	1.20E+00	5.60E+00	2.42E+01	3.10E+00	3.90E+00

SOURCE: Reference 30

TABLE 11. TITANIUM (Ti) (Continued)

ω(cm⁻¹)	λ(μm)	-ε1	ε2	n	k
1.00E+03	1.00E+01	2.36E+02	3.21E+02	9.01E+00	1.78E+01
1.05E+03	9.50E+00	2.19E+02	2.93E+02	8.56E+00	1.71E+01
1.11E+03	9.00E+00	2.18E+02	2.51E+02	7.56E+00	1.66E+01
1.18E+03	8.50E+00	2.11E+02	2.24E+02	6.96E+00	1.61E+01
1.25E+03	8.00E+00	1.76E+02	1.94E+02	6.56E+00	1.48E+01
1.33E+03	7.50E+00	1.53E+02	1.75E+02	6.31E+00	1.39E+01
1.43E+03	7.00E+00	1.38E+02	1.58E+02	5.99E+00	1.32E+01
1.54E+03	6.50E+00	1.17E+02	1.37E+02	5.63E+00	1.22E+01
1.67E+03	6.00E+00	9.87E+01	1.22E+02	5.38E+00	1.13E+01
1.82E+03	5.50E+00	8.04E+01	1.04E+02	5.07E+00	1.03E+01
2.00E+03	5.00E+00	6.06E+01	8.94E+01	4.87E+00	9.18E+00
2.22E+03	4.50E+00	4.34E+01	7.52E+01	4.66E+00	8.07E+00
2.50E+03	4.00E+00	3.11E+01	6.78E+01	4.66E+00	7.27E+00
2.86E+03	3.50E+00	2.25E+01	6.00E+01	4.56E+00	6.58E+00
3.33E+03	3.00E+00	1.31E+01	5.33E+01	4.57E+00	5.83E+00
4.00E+03	2.50E+00	8.17E+00	4.93E+01	4.57E+00	5.39E+00
5.00E+03	2.00E+00	4.24E+00	4.24E+01	4.38E+00	4.84E+00

SOURCE: Reference 31

TABLE 12. TUNGSTEN (W)

ω(cm^{-1})	λ(μm)	-ε1	ε2	n	k
5.00E+02	2.00E+01	4.32E+03	2.38E+03	1.75E+01	6.80E+01
5.26E+02	1.90E+01	3.70E+03	2.05E+03	1.63E+01	6.30E+01
5.56E+02	1.80E+01	3.56E+03	1.90E+03	1.54E+01	6.16E+01
5.88E+02	1.70E+01	3.37E+03	1.80E+03	1.50E+01	6.00E+01
6.25E+02	1.60E+01	3.32E+03	1.91E+03	1.60E+01	5.98E+01
6.67E+02	1.50E+01	3.19E+03	1.69E+03	1.45E+01	5.83E+01
7.14E+02	1.40E+01	2.94E+03	1.43E+03	1.28E+01	5.57E+01
7.69E+02	1.30E+01	2.65E+03	1.13E+03	1.07E+01	5.26E+01
8.33E+02	1.20E+01	2.42E+03	1.10E+03	1.09E+01	5.04E+01
9.09E+02	1.10E+01	2.05E+03	8.80E+02	9.50E+00	4.63E+01
1.00E+03	1.00E+01	1.65E+03	6.85E+02	8.25E+00	4.15E+01
1.05E+03	9.50E+00	1.51E+03	5.85E+02	7.40E+00	3.95E+01
1.11E+03	9.00E+00	1.36E+03	5.49E+02	7.30E+00	3.76E+01
1.18E+03	8.50E+00	1.18E+03	4.48E+02	6.40E+00	3.50E+01
1.21E+03	8.25E+00	1.13E+03	4.10E+02	6.00E+00	3.42E+01
1.25E+03	8.00E+00	1.07E+03	4.06E+02	6.10E+00	3.33E+01
1.29E+03	7.76E+00	1.01E+03	3.49E+02	5.40E+00	3.23E+01
1.33E+03	7.50E+00	9.34E+02	3.19E+02	5.15E+00	3.10E+01
1.38E+03	7.25E+00	8.43E+02	3.07E+02	5.20E+00	2.95E+01
1.43E+03	7.00E+00	7.72E+02	3.03E+02	5.35E+00	2.83E+01
1.48E+03	6.75E+00	6.68E+02	2.85E+02	5.40E+00	2.64E+01
1.54E+03	6.50E+00	5.90E+02	2.47E+02	5.03E+00	2.48E+01
1.60E+03	6.25E+00	5.42E+02	2.33E+02	4.90E+00	2.38E+01
1.67E+03	6.00E+00	4.87E+02	2.19E+02	4.85E+00	2.26E+01
1.74E+03	5.75E+00	5.00E+02	2.05E+02	4.50E+00	2.28E+01
1.82E+03	5.50E+00	4.82E+02	2.01E+02	4.48E+00	2.24E+01
1.90E+03	5.25E+00	4.80E+02	1.83E+02	4.11E+00	2.23E+01
2.00E+03	5.00E+00	4.37E+02	1.48E+02	3.48E+00	2.12E+01
2.11E+03	4.75E+00	3.81E+02	1.32E+02	3.33E+00	1.98E+01
2.22E+03	4.50E+00	3.88E+02	1.13E+02	2.85E+00	1.99E+01
2.27E+03	4.40E+00	3.85E+02	1.05E+02	2.65E+00	1.98E+01
2.38E+03	4.20E+00	3.55E+02	9.50E+01	2.50E+00	1.90E+01
2.44E+03	4.10E+00	3.48E+02	8.65E+01	2.30E+00	1.88E+01
2.50E+03	4.00E+00	3.30E+02	8.16E+01	2.23E+00	1.83E+01
2.56E+03	3.90E+00	3.15E+02	7.95E+01	2.22E+00	1.79E+01
2.70E+03	3.70E+00	2.81E+02	7.44E+01	2.20E+00	1.69E+01
2.78E+03	3.60E+00	2.68E+02	6.60E+01	2.00E+00	1.65E+01
2.94E+03	3.40E+00	2.35E+02	7.19E+01	2.32E+00	1.55E+01
3.03E+03	3.30E+00	2.17E+02	6.73E+01	2.26E+00	1.49E+01
3.13E+03	3.20E+00	2.08E+02	6.48E+01	2.22E+00	1.46E+01
3.23E+03	3.10E+00	1.97E+02	6.25E+01	2.20E+00	1.42E+01
3.33E+03	3.00E+00	1.84E+02	7.18E+01	2.60E+00	1.38E+01
3.45E+03	2.90E+00	1.76E+02	6.89E+01	2.55E+00	1.35E+01
3.57E+03	2.80E+00	1.80E+02	6.26E+01	2.30E+00	1.36E+01
3.70E+03	2.70E+00	1.54E+02	5.29E+01	2.10E+00	1.26E+01
3.85E+03	2.60E+00	1.39E+02	5.16E+01	2.15E+00	1.20E+01
4.00E+03	2.50E+00	1.28E+02	4.71E+01	2.05E+00	1.15E+01
4.17E+03	2.40E+00	1.28E+02	4.95E+01	2.15E+00	1.15E+01

SOURCE: Reference 32

TABLE 12. TUNGSTEN (W) (Continued)

ω(cm^{-1})	λ(μm)	$-\epsilon_1$	ϵ_2	n	k
4.35E+03	2.30E+00	9.80E+01	4.04E+01	2.00E+00	1.01E+01
4.55E+03	2.20E+00	8.85E+01	3.65E+01	1.90E+00	9.60E+00
4.76E+03	2.10E+00	7.58E+01	3.29E+01	1.85E+00	8.90E+00
5.00E+03	2.00E+00	6.09E+01	2.80E+01	1.75E+00	8.00E+00
5.26E+03	1.90E+00	4.86E+01	2.90E+01	2.00E+00	7.25E+00
5.56E+03	1.80E+00	4.12E+01	2.84E+01	2.10E+00	6.75E+00
5.71E+03	1.75E+00	3.89E+01	2.62E+01	2.00E+00	6.55E+00
5.88E+03	1.70E+00	3.34E+01	2.58E+01	2.10E+00	6.15E+00
6.02E+03	1.66E+00	3.27E+01	2.98E+01	2.40E+00	6.20E+00
6.25E+03	1.60E+00	3.88E+01	3.51E+01	2.60E+00	6.75E+00
6.45E+03	1.55E+00	2.51E+01	2.80E+01	2.50E+00	5.60E+00
6.67E+03	1.50E+00	2.08E+01	3.13E+01	2.90E+00	5.40E+00
6.90E+03	1.45E+00	1.75E+01	3.09E+01	3.00E+00	5.15E+00
7.14E+03	1.40E+00	1.73E+01	3.36E+01	3.20E+00	5.25E+00
7.41E+03	1.35E+00	1.64E+01	3.30E+01	3.20E+00	5.16E+00
7.69E+03	1.30E+00	1.53E+01	3.23E+01	3.20E+00	5.05E+00
8.33E+03	1.20E+00	1.15E+01	2.85E+01	3.10E+00	4.60E+00
9.09E+03	1.10E+00	9.78E+00	2.61E+01	3.01E+00	4.34E+00
1.00E+04	1.00E+00	3.25E+00	2.10E+01	3.00E+00	3.50E+00

TABLE 12. TUNGSTEN (W) (Continued)

ω(cm⁻¹)	λ(μm)	-ε1	ε2	n	k
4.84E+02	2.07E+01	5.68E+03	5.71E+03	3.45E+01	8.29E+01
5.65E+02	1.77E+01	4.75E+03	3.91E+03	2.65E+01	7.39E+01
6.45E+02	1.55E+01	3.83E+03	2.73E+03	2.09E+01	6.53E+01
7.26E+02	1.38E+01	3.31E+03	2.04E+03	1.70E+01	6.00E+01
8.07E+02	1.24E+01	2.80E+03	1.54E+03	1.41E+01	5.47E+01
9.68E+02	1.03E+01	2.05E+03	9.37E+02	1.01E+01	4.64E+01
1.13E+03	8.86E+00	1.56E+03	6.09E+02	7.58E+00	4.02E+01
1.29E+03	7.75E+00	1.21E+03	4.18E+02	5.92E+00	3.53E+01
1.61E+03	6.20E+00	7.86E+02	2.19E+02	3.87E+00	2.83E+01
2.42E+03	4.13E+00	3.32E+02	6.71E+01	1.83E+00	1.83E+01
3.23E+03	3.10E+00	1.70E+02	5.11E+01	1.94E+00	1.32E+01
4.03E+03	2.48E+00	1.09E+02	2.95E+01	1.40E+00	1.05E+01
4.84E+03	2.07E+00	6.19E+01	1.93E+01	1.21E+00	7.96E+00
5.65E+03	1.77E+00	3.50E+01	1.95E+01	1.59E+00	6.13E+00
6.61E+03	1.51E+00	1.57E+01	2.18E+01	2.36E+00	4.61E+00
7.26E+03	1.38E+00	1.00E+01	2.76E+01	3.11E+00	4.44E+00
8.07E+03	1.24E+00	8.80E+00	2.71E+01	3.14E+00	4.32E+00
1.21E+04	8.27E-01	-4.33E+00	1.94E+01	3.48E+00	2.79E+00
1.61E+04	6.20E-01	-4.61E+00	2.08E+01	3.60E+00	2.89E+00

SOURCE: Reference 33

TABLE 13. Optical Parameters Found using a Drude Model Fit of the Experimental Dielectric Functions for Six Metals

	$\omega_f(cm^{-1})$ for fit of data in IR	$\omega_\tau(cm^{-1})$ IR fit	$\omega_p(cm^{-1})$ IR fit	$-\varepsilon_1(0) = -(\omega_p/\omega_\tau)^2$	$\omega_\tau(cm^{-1})$ from dc resistivities and ω_p	$\omega_\tau(cm^{-1})$ crossover on $-\varepsilon_1$, ε_2 plot
Al	1.11×10^3	6.47×10^2	1.19×10^5	3.37×10^4	6.45×10^2	7.00×10^2
Cu	2.00×10^3	2.78×10^2	6.38×10^4	5.27×10^4	1.15×10^2	2.55×10^2
Au	8.06×10^2	2.16×10^2	7.25×10^4	1.13×10^5	1.93×10^2	2.16×10^2
Pb	5.00×10^1	1.45×10^3	6.20×10^4	1.33×10^3	1.35×10^3	1.55×10^3
Ag	1.00×10^3	1.45×10^2	7.25×10^4	2.50×10^5	1.41×10^2	1.52×10^2
W	8.06×10^2	4.33×10^2	4.84×10^4	1.25×10^4	2.16×10^2	4.30×10^2

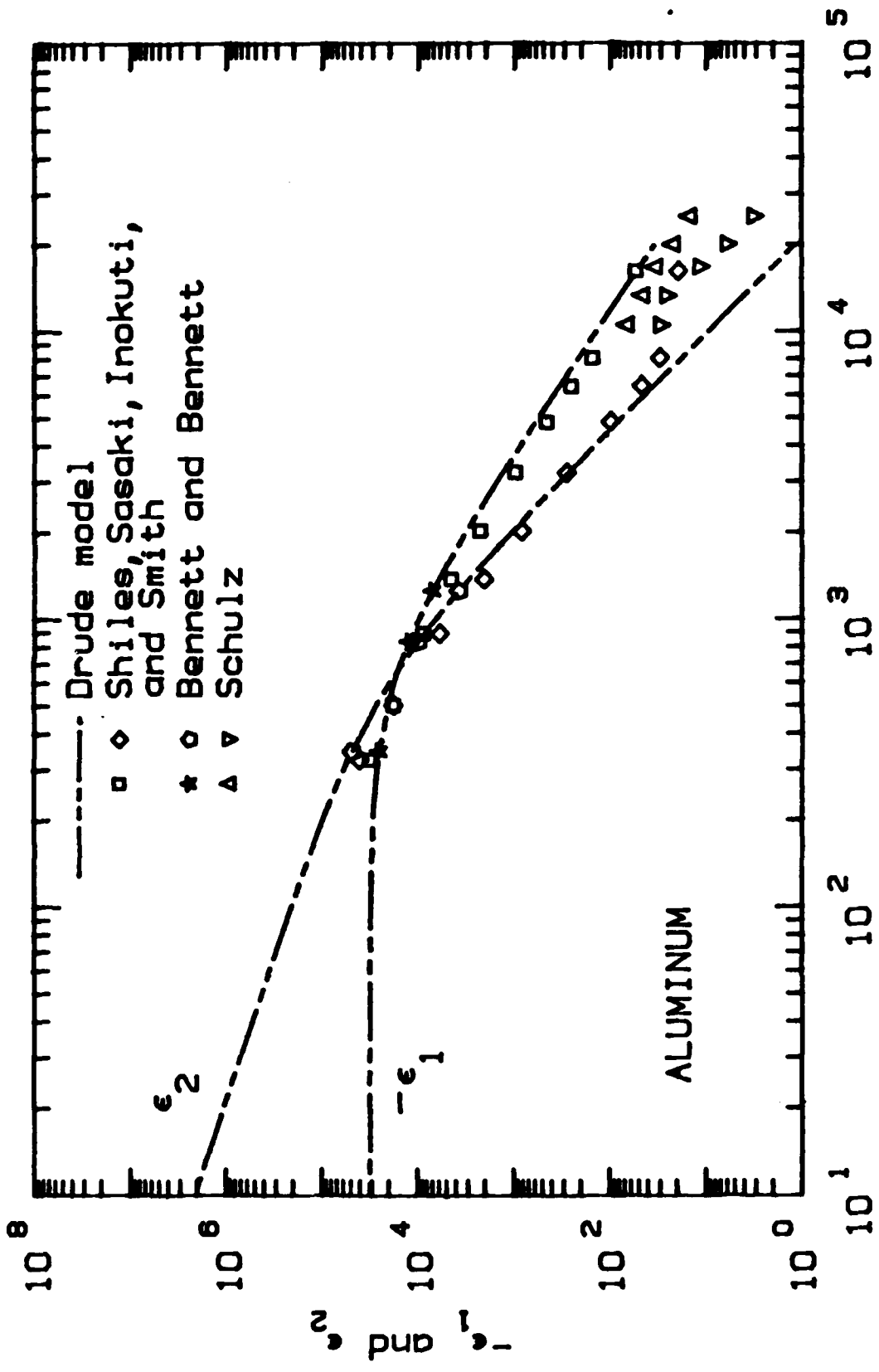

Fig. 1. Aluminum: $-\epsilon_1(\omega)$ and $\epsilon_2(\omega)$ vs frequency. The solid line is the Drude model.

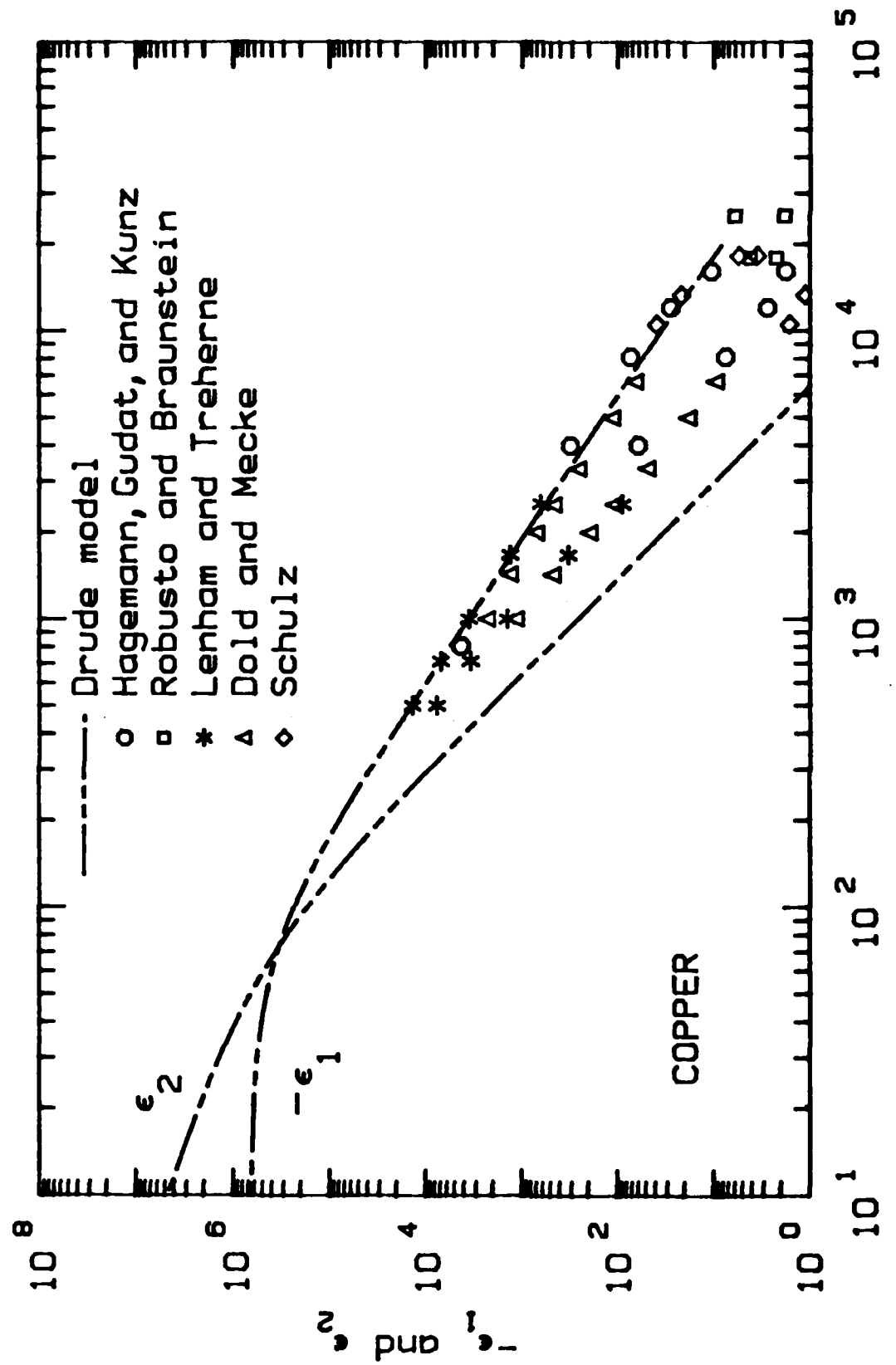

Fig. 2. Copper: $-\epsilon_1(\omega)$ and $\epsilon_2(\omega)$ vs frequency. The solid line is the Drude model.

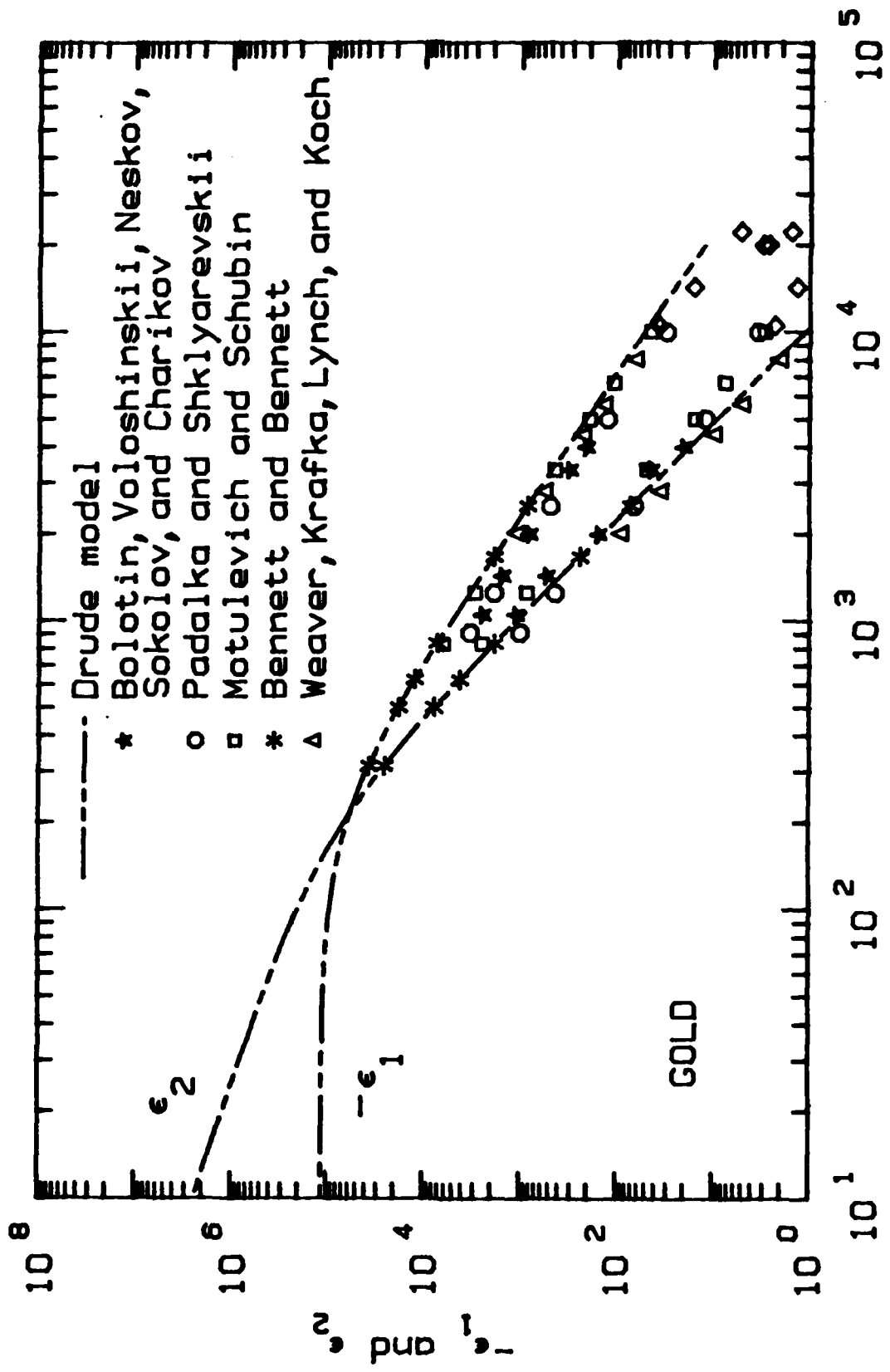

Fig. 3. Gold: $-\epsilon_1(\omega)$ and $\epsilon_2(\omega)$ vs frequency. The solid line is the Drude model.

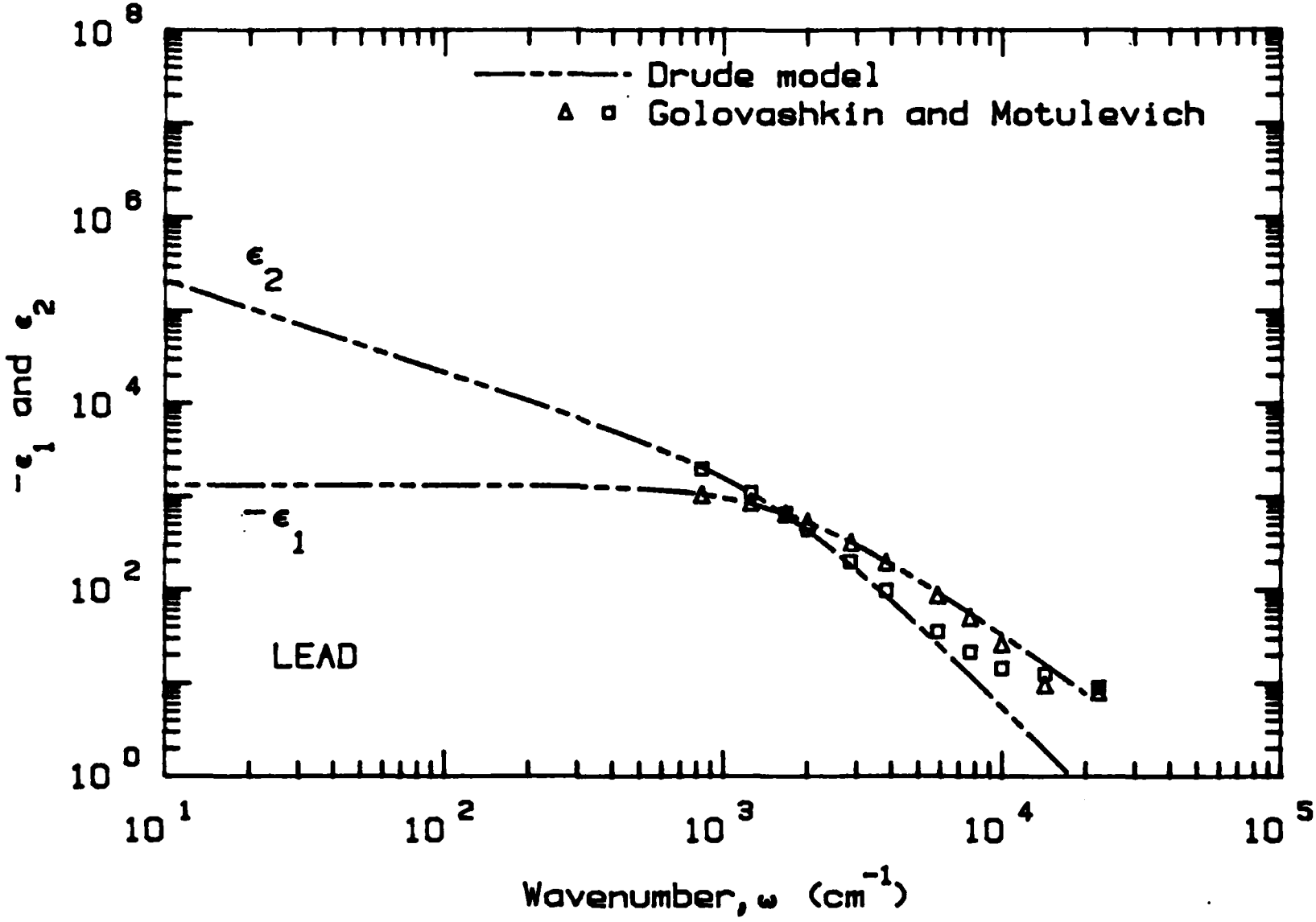

Fig. 4. Lead: $-\varepsilon_1(\omega)$ and $\varepsilon_2(\omega)$ vs frequency. The solid line represents the Drude model.

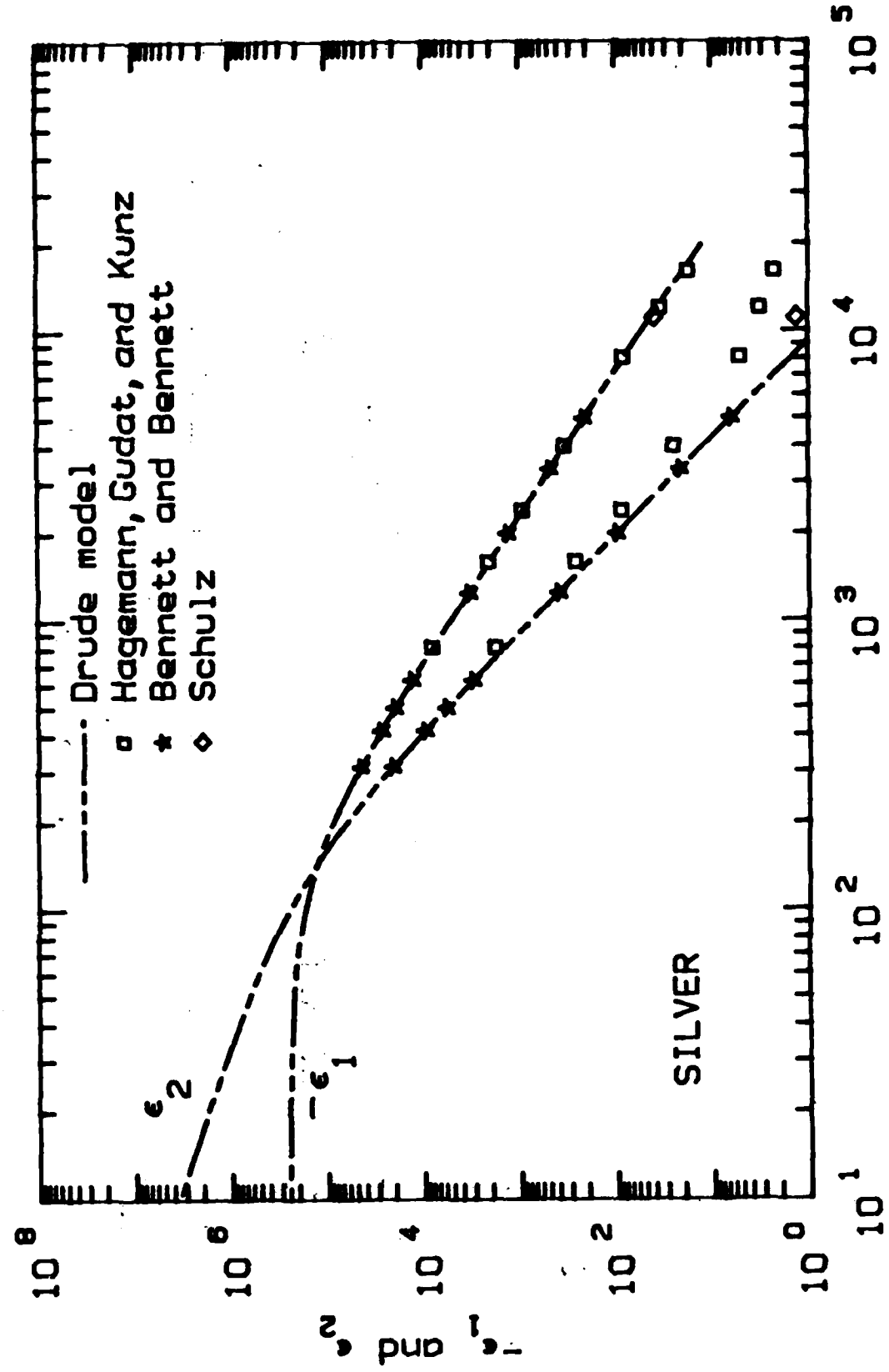

Fig. 5. Silver: $-\epsilon_1(\omega)$ and $\epsilon_2(\omega)$ vs frequency. The solid line is the Drude model.

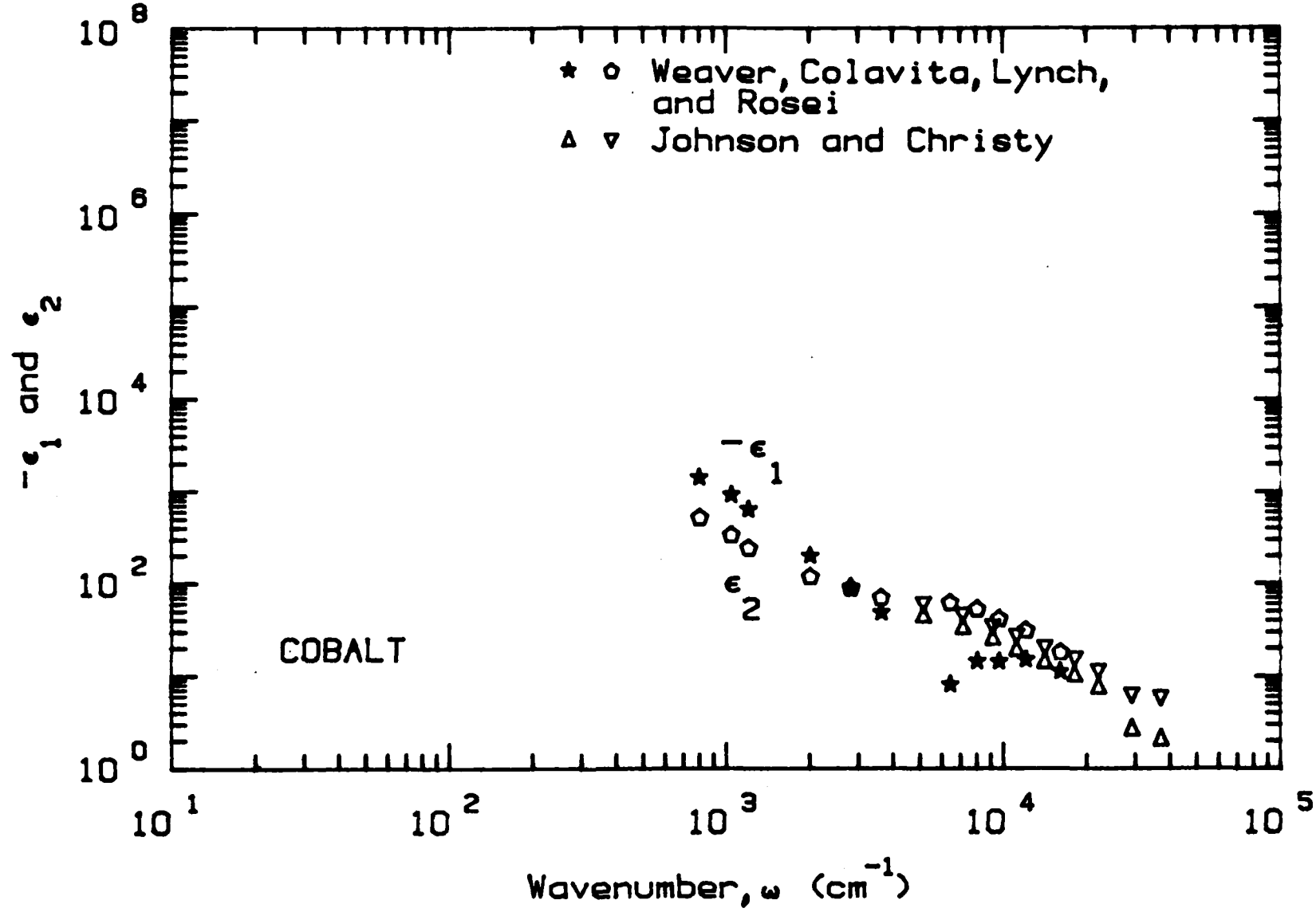

Fig. 6. Cobalt: $-\epsilon_1(\omega)$ and $\epsilon_2(\omega)$ vs frequency.

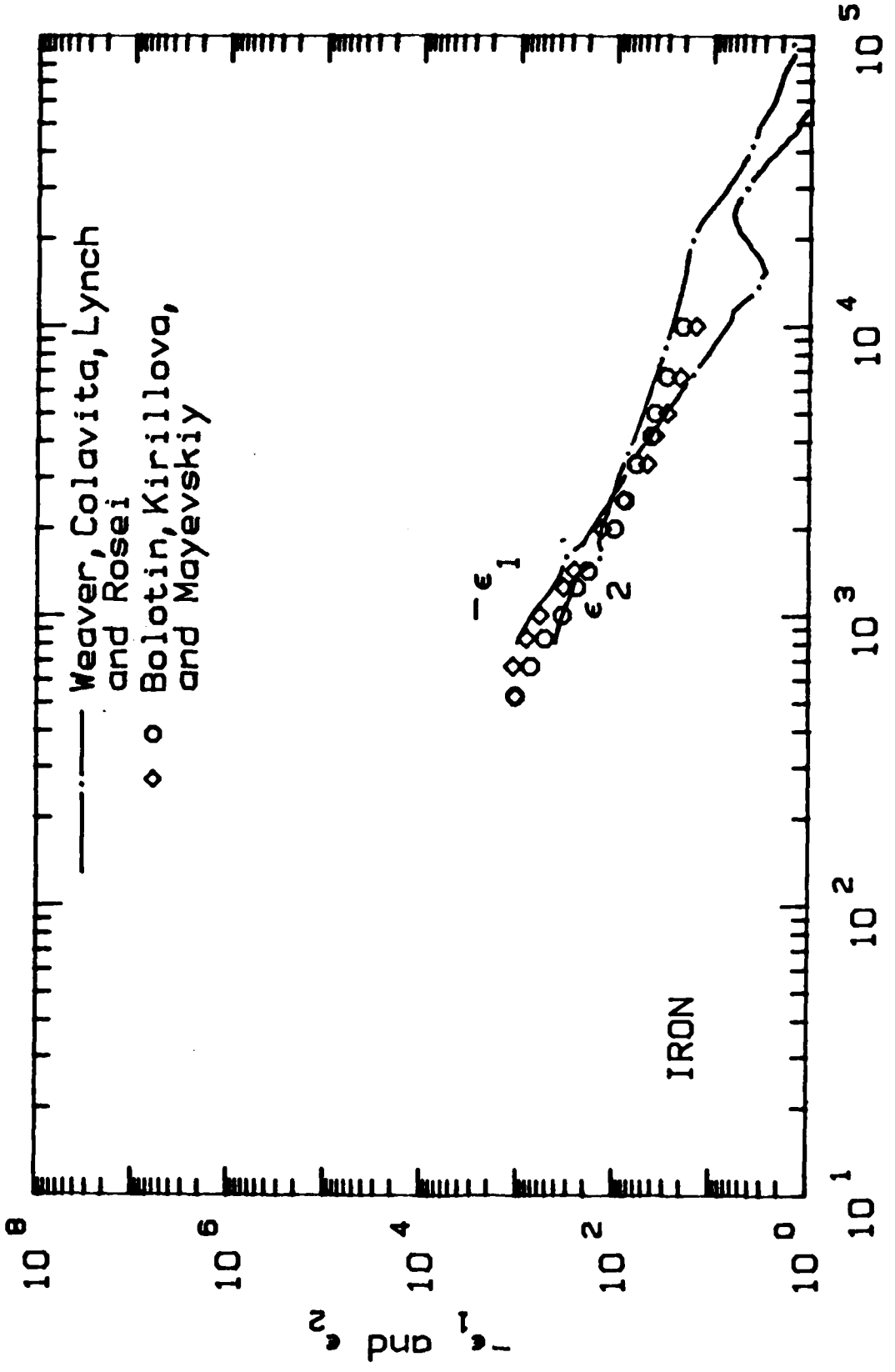

Fig. 7. Iron: $-\varepsilon_1(\omega)$ and $\varepsilon_2(\omega)$ vs frequency.

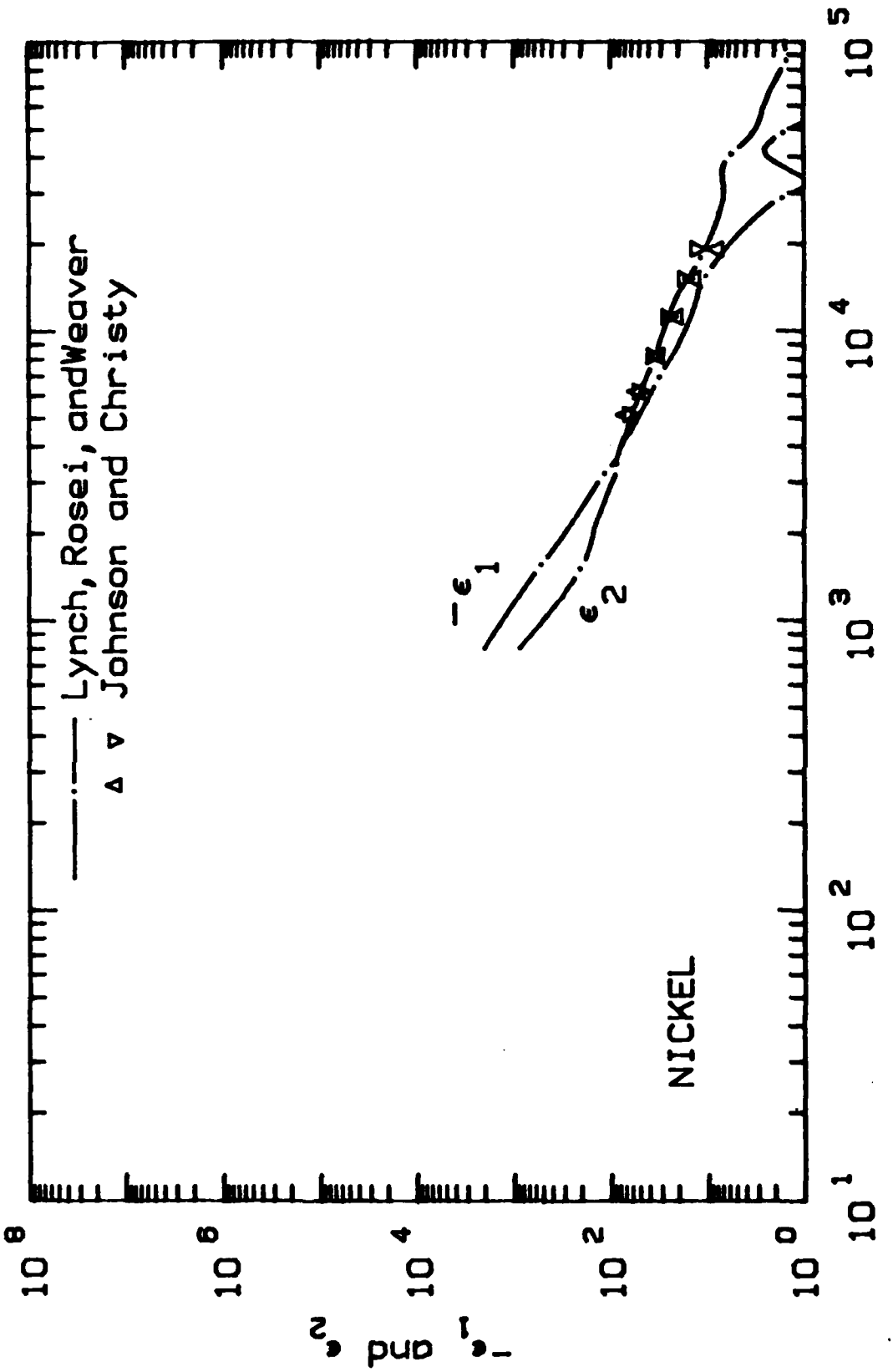

Fig. 8. Nickel: $-\epsilon_1(\omega)$ and $\epsilon_2(\omega)$ vs frequency.

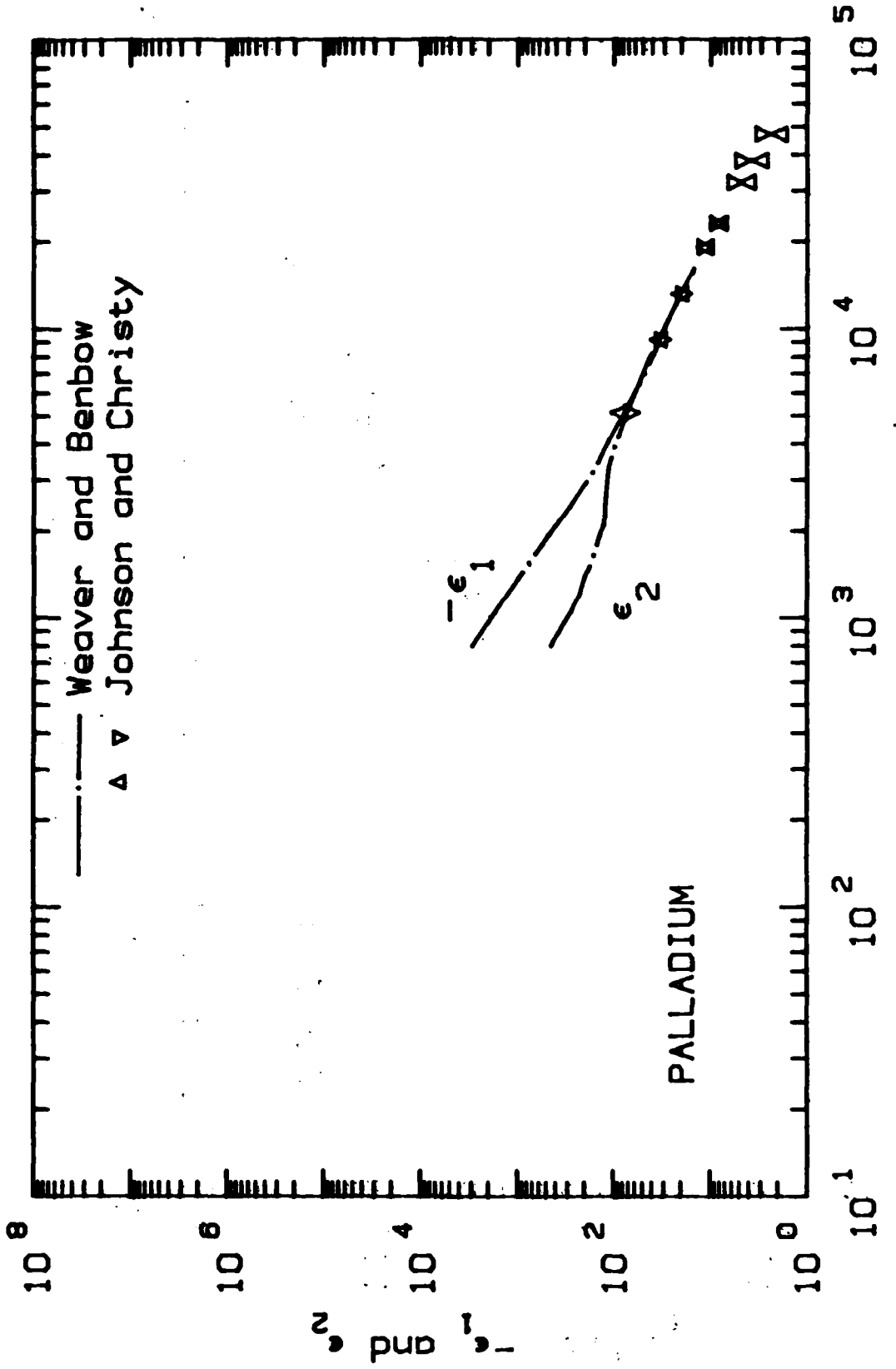

Fig. 9. Palladium: $-\epsilon_1(\omega)$ and $\epsilon_2(\omega)$ vs frequency.

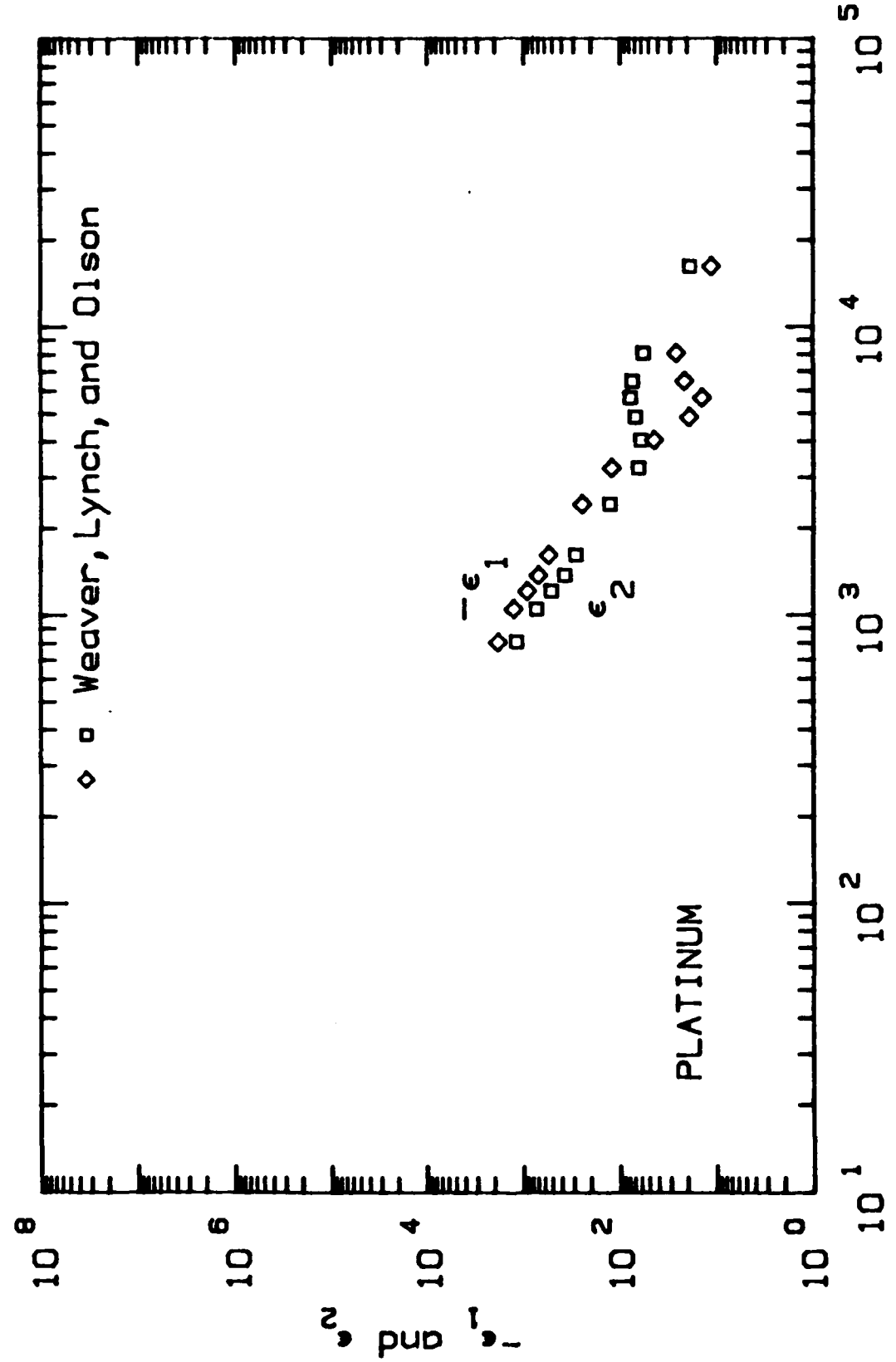

Fig. 10. Platinum: $-\epsilon_1(\omega)$ and $\epsilon_2(\omega)$ vs frequency.

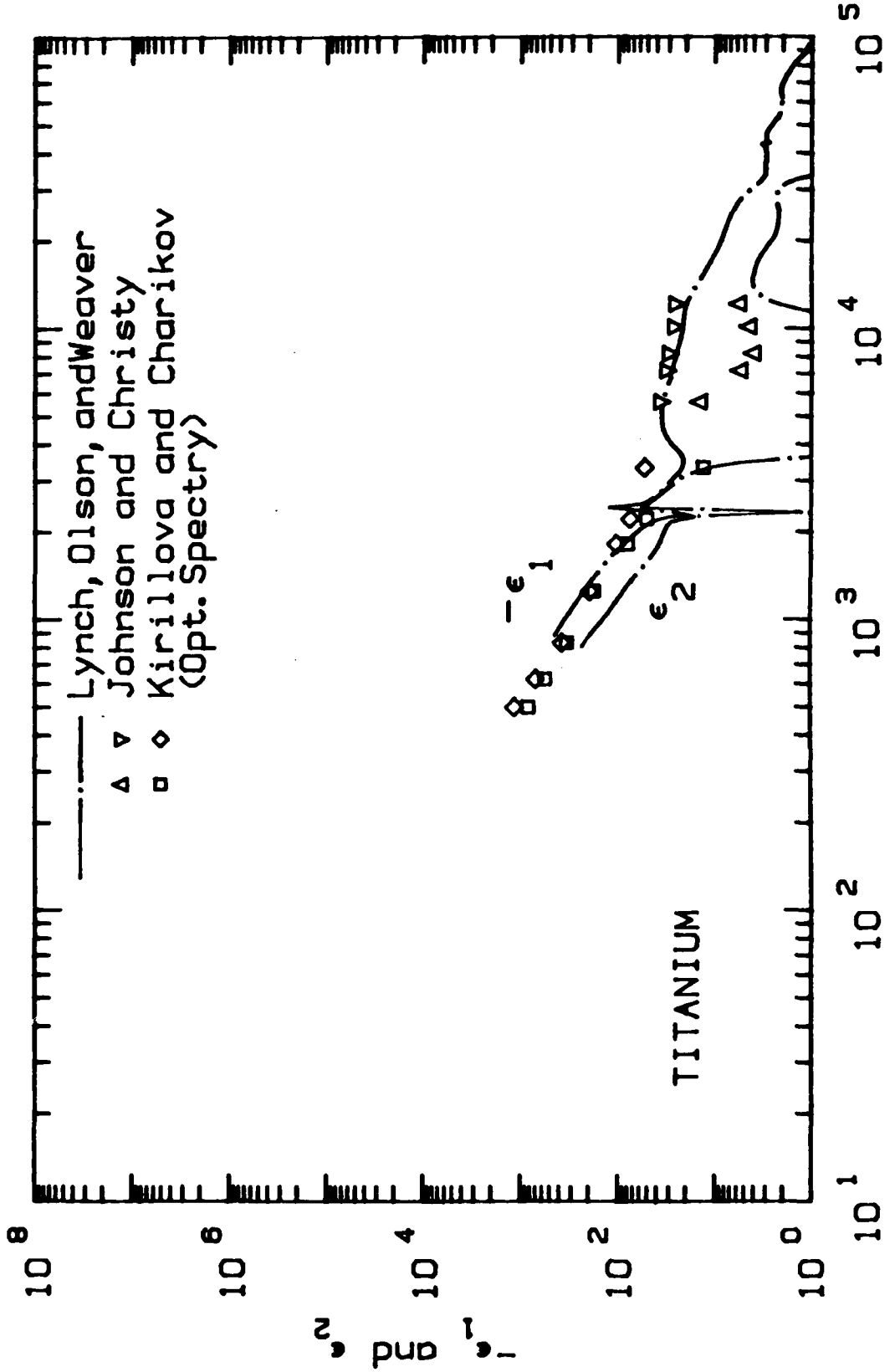

Fig. 11. Titanium: $-\epsilon_1(\omega)$ and $\epsilon_2(\omega)$ vs frequency.

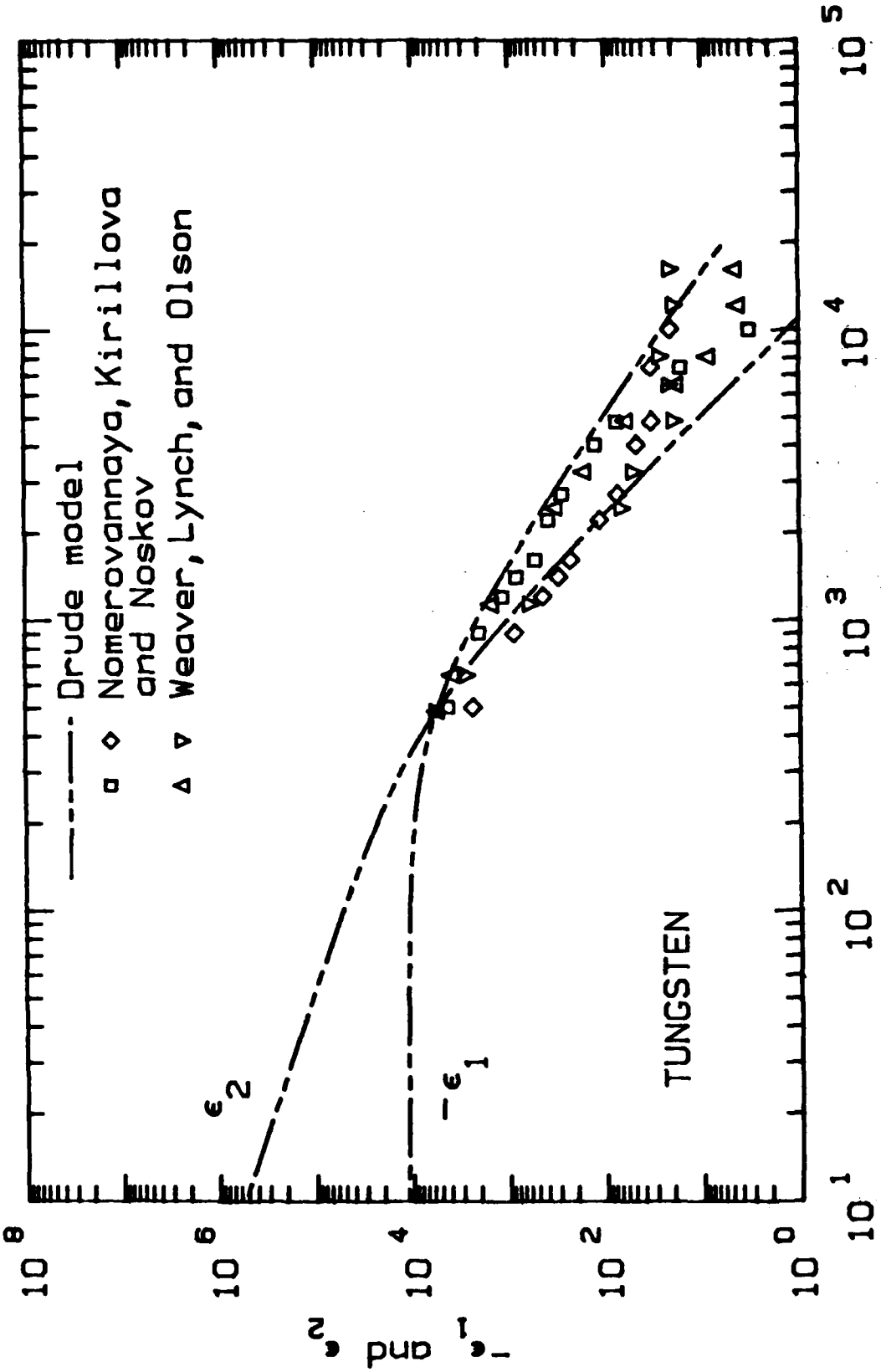

Fig. 12. Tungsten: $-\varepsilon_1(\omega)$ and $\varepsilon_2(\omega)$ vs frequency. The solid line is the Drude model.

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