Photoconductivity Spectrum of Biphenyl

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Photoconductivity of biphenyl has been studied by Lyons1 using the mercury lines at 254, 255 and 280 mμ. Kommandeur2 and Baessler3 have determined the photoconductivity of biphenyl in the molten state.

We have studied the bulk photoconductivity of biphenyl in a sandwich type cell, the crystal being illuminated with polarized light in the spectral region lying between 220 and 330 mμ. The light source was a Xenon lamp (OSRAM XBO 900); the light was monochromatized by a Hilger & Watts grating monochromator and polarized by a glan-air polarizing prism. Single crystals have been used, whose thickness ranged from 100 to 140 μ. They were obtained by sublimation of the substance which had been previously purified by means of chromatography and zone refining (20 passes). Measurements have been carried out in d.c., and solutions either of KCl, or HCl, or KOH 0.1 M were used as transparent electrode; the second electrode was "aquadag". The maximum sensitivity of our measurements was 10−14 A.

Figure 1 a shows the absorption spectra of single crystals of biphenyl with respect to the two crystallographic directions a and b. Figures 1b, 1c, 1d show the photoconductivity spectra of biphenyl, which were obtained by illumination of the positive electrode; the photocurrent was normalized to equal light quanta of incident light.

Data relative to one crystal are given in Table I; these data are not exactly reproducible for all the crystals; however the qualitative trend is always the same.

The lowest photocurrent values were obtained when the positive electrode used was the alkaline solution.

The photocurrent is directly proportional to the light intensity for different wavelengths corresponding to a maxi-


Fig. 1. a) Absorption spectrum of single crystals4. b) Photoconductivity spectrum; the positive electrode (HCl 0.1 M) is illuminated. c) Photoconductivity spectrum; the positive electrode (KCl 0.1 M) is illuminated. d) Photoconductivity spectrum; the positive electrode (KOH 0.1 M) is illuminated. The dotted curves refer to light polarized // a-axis of the crystal; the full drawn curves refer to light polarized // b-axis of the crystal.
Table 1. Photocurrent values obtained in a crystal whose thickness is of 140 μ; the applied voltage is 100 V; the surface area of the illuminated electrode is equal to \(3.14 \times 10^{-2}\) cm².

<table>
<thead>
<tr>
<th>Electrode solution</th>
<th>λ (μm)</th>
<th>Photons/sec/cm²</th>
<th>//a-ax (A/cm²)</th>
<th>//b-ax (A/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCl 0.1 M</td>
<td>250</td>
<td>7.3 \times 10^{11}</td>
<td>1.2 \times 10^{-10}</td>
<td>9.2 \times 10^{-11}</td>
</tr>
<tr>
<td></td>
<td>308</td>
<td>2.1 \times 10^{13}</td>
<td>6.4 \times 10^{-10}</td>
<td>6.4 \times 10^{-11}</td>
</tr>
<tr>
<td>KCl 0.1 M</td>
<td>250</td>
<td>7.3 \times 10^{11}</td>
<td>1.2 \times 10^{-10}</td>
<td>7.3 \times 10^{-11}</td>
</tr>
<tr>
<td></td>
<td>308</td>
<td>2.1 \times 10^{13}</td>
<td>4.8 \times 10^{-11}</td>
<td>4.8 \times 10^{-11}</td>
</tr>
<tr>
<td>KOH 0.1 M</td>
<td>250</td>
<td>7.3 \times 10^{11}</td>
<td>3.8 \times 10^{-11}</td>
<td>2.9 \times 10^{-11}</td>
</tr>
<tr>
<td></td>
<td>308</td>
<td>2.1 \times 10^{13}</td>
<td>4.8 \times 10^{-11}</td>
<td>4.8 \times 10^{-11}</td>
</tr>
</tbody>
</table>

Fig. 2. Plot of the inverse photocurrent vs. 1/\(ε\) for acidic (empty circles) and alkaline (full circles) electrodes.

Fig. 3. Photoconductivity spectrum; the negative electrode is illuminated. The arb. units are the same as in Fig. 1.