DETERMINATION OF ALUMINIUM IN LUTETIUM
BY INSTRUMENTAL
NEUTRON ACTIVATION ANALYSIS

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(Received November 18, 1975)

In lutetium metal 45 ppm aluminium have been determined by instrumental neutron activation analysis. Interference from the very intensive γ-radiation of $^{176m}$Lu was eliminated by application of lead filters. The determination limit of the method was estimated to be 0.7 μg or 3 ppm Al.

Introduction

During experiments on the superconductivity of rare earth metals, one lutetium sample with a comparably high transition temperature was found.* Therefore the composition of this sample was thoroughly studied and the trace impurities had to be analyzed. The results of an investigation by spark source mass spectrometry were generally in agreement with the manufacturers data. However a large discrepancy was found concerning the aluminium content and another analytical method had to be employed, to check the values obtained.

Since its isotopes have high activation cross-sections for thermal neutrons, the matrix lutetium is generally not accessible to trace determination by instrumental thermal neutron activation analysis. As can be estimated from the data in Table 1, even at short time irradiations of about 1 min the activity of $^{176m}$Lu will be several orders higher than that of $^{28}$Al from the impurity. Usually such high matrix activities will interfere the γ-ray measurement even if the γ-ray energies are well distinct, since detector and electronic equipment are overloaded by the incident pulses. In the case in question, however, this problem could be overcome, since the γ-ray line of the mainly interfering $^{176m}$Lu can be strongly and nearly selectively filtered out by a foil of lead.

*These experiments were carried out by Dr. J. WITTIG at the Institute of Solid State Research, KFA Jülich.
### Table 1

<table>
<thead>
<tr>
<th>Isotopic abundance, %</th>
<th>Neutron activation product</th>
<th>Half-life, αth</th>
<th>Activity*</th>
<th>Energy, keV</th>
<th>γ-lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>(^{27})Al</td>
<td>2.24 m</td>
<td>245 ± 5 mb</td>
<td>5.6 · 10^8</td>
<td>17.79</td>
</tr>
<tr>
<td>97.4</td>
<td>(^{176})mLu</td>
<td>3.69 h</td>
<td>547 ± 81 b</td>
<td>11.1 · 10^7</td>
<td>88.35</td>
</tr>
<tr>
<td>2.6</td>
<td>(^{177})mLu</td>
<td>161 d</td>
<td>7 ± 2 b</td>
<td>7.6 · 10^7</td>
<td>many up to 420 keV</td>
</tr>
<tr>
<td>6.71 d</td>
<td>(^{178})Lu</td>
<td>2050 b</td>
<td>1069 ± 41 b</td>
<td>5.3 · 10^8</td>
<td>208.3</td>
</tr>
</tbody>
</table>

*Per 1 g element irradiated for 1 min in a thermal neutron flux of 4 · 10^13 n · cm^−2 · sec^−1.*

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**J. Radioanal. Chem. 32 (1976)**