In order to attain a fair reliability for telecommunication purposes, integrated circuits (I. C.) must be adequately protected against the environment. Commonly, a combination of a coating of a passive, dielectric, insulating material and an hermetically sealed package is used. However, it has been shown that this does not always adequately prevent corrosion of the conductor tabs and wire bond connections. Reliability studies have proven that corrosion phenomena and device instability caused by gas impurities are responsible for the most frequent long-term-failures. Consequently, it is essential that the packing of these devices is done with perfect hermeticity under an inert atmosphere with a low moisture content. A complete analysis of the package atmosphere is therefore considered to be an essential part of quality control in high reliability manufacturing. At the research laboratories of Bell Telephone Mfg. Cy. div. Gent, residual gas analysis by mass spectrometry is used to accurately measure the moisture content and the gases enclosed in the package.

Certain suppliers and manufacturers of hermetically sealed devices claim that dry air is inert enough to be used as a sealing gas. However, certain life testing experiments indicated that air should be avoided. The phenomenon of corrosion of the Al bond wire was specifically observed for air sealed TO-39 transistors of which a
scheme is given in Fig. 1, but may be generalised for other devices in a similar environment.

![Fig. 1. Scheme of a TO-39 type transistor, indicating the important parts: metal can (1), Ni-base plate (2), Ni foot (3), sealing glass bead (4), Al bond wire (5) and I. C. (6).](image)

In order to study the observed corrosion phenomena and to identify the critical parameters and their influence, corrosion simulation tests are mandatory. A multi-technique approach, using several surface-sensitive methods will be described for obtaining information on the corrosion processes.

**Instrumentation**

*Electron Spectroscopy: Auger and X-Ray Photoelectron Spectroscopy*

Auger Electron Spectroscopy (AES-SAM) measurements were performed with a Physical Electronics Industries — 590 Scanning Auger electron spectrometer. The primary electron beam of 5 keV energy and 0.5 µA current is incident at 60° with the sample surface. Sputtering was obtained using 4 keV Ar⁺ ions. The pressure in the analyser chamber is \(7 \times 10^{-8}\) Pa. When profiling, the pressure rises to \(7 \times 10^{-5}\) Pa. All data were collected in the derivative mode using a CMA with 0.6% resolution.

The X-Ray Photoelectron Spectroscopy (XPS-ESCA) apparatus is of the Physical Electronics Industries type 590 equipped with a Mg X-ray gun (Mg-Kx=1253.6 eV). It is operated at 10 keV and 40 mA. The photoelectrons are analysed with a double pass CMA with a resolution of 1.2%.