A local electrochemical approach to study corrosion in plastic encapsulated semiconductor devices

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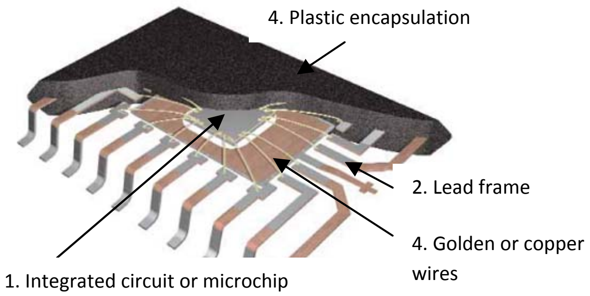
Plastic encapsulated semiconductor devices are present in our daily life inside of our cars, computers, telephones and other electronic devices. The structure of the device is complex and its assembly is a multiple task. Encapsulation is a final step of assembly and is used for environmental protection of the device. An example of encapsulated devices is shown in fig. 1, left. Heart of the device is an integrated circuit (1) which is connected to the lead frame (2) via gold or copper wires (3) and is encapsulated in plastic (4).



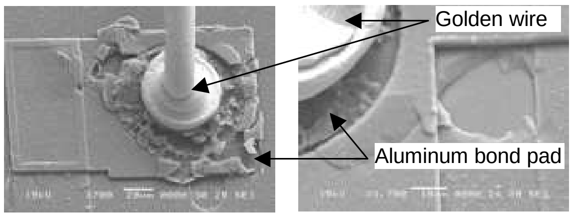


Figure 1 Schematic picture of plastic encapsulated device (left) and an example of aluminum bond pad corrosion (right)

Reliability of the devices depends on many factors, e.g. materials, assembly, usage, environmental conditions and many others [1, 2]. Corrosion of the device is a major reliability risk. Even small amounts of corrosion can cause a problem or a failure of the devices. Particularly, corrosion of metallization pads can be a significant issue (fig.1, right). The most common metallization is aluminum alloyed with small quantities of copper and/or silicon. Both positively and negatively biased aluminum metallization are susceptible to corrosion due to the amphoteric nature of aluminum. In the corrosive process reported, water permeates into the encapsulating plastics and diffuses to the bond-pads. While the ions arrive and accumulate at sites liable to corrosion, the electrochemical reaction occurs between the ionic aqueous solution and the metallization of the bond-pad [3]. In order to avoid corrosion and to increase reliability, it is crucial to study and control the moisture transporting path and the corrosive mechanisms.

Our initial aim is to understand corrosion mechanisms of aluminum bond pads. Taking into account the complex structure of the device and the small dimensions of the aluminum pads

(~50-100 μm) a special experimental approach is developed. Aluminum metallization lines together with gold are fabricated on a silicon wafer using the semiconductor technology in a clean room. Three dimensional electrodes are mimicked by two dimensional model specimens allowing the use of micro-electrochemical local probe techniques.

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