Novel electrochemical approach to study corrosion mechanism of Al-Au wire-bond pad interconnections

A gold-aluminium material combination is typically employed as an interconnection for microelectronic devices. One of the reliability risks of such devices is that of corrosion of aluminium bond pads resulting from the galvanic coupling between an aluminium bond pad and a gold wire. The research presented in this manuscript focuses on studying bond pad corrosion by selecting an appropriate model system and a dedicated set of electrochemical and analytical experimental tools. Taking into account the complex three-dimensional structure and the small dimensions of Au-Al interconnections (around 50-100 μm), a dedicated and novel experimental approach was developed. Au-Al covered silicon chips were developed under clean room conditions. Three-dimensional electrodes were mimicked as flat, two-dimensional bond pad model systems, allowing the use of microelectrochemical local probe techniques. Thin gold films were applied on Ti-Al covered silicon surfaces, and their morphology and electrochemical behaviour were analysed using the localised electrochemical cell, scanning vibrating electrode technique, scanning electron microscopy-energy dispersive X-ray spectroscopy, scanning electron microscopy-focused ion beam and Auger electron spectroscopy. The results revealed that the electrochemical behaviour of thin gold films was influenced by the underlying metal layers and the microstructural changes during heat treatment. The effect of the underlying layers on the electrochemical properties of the top gold layer was attributed to a mixed potential behaviour and microgalvanic interactions, which was more pronounced after heat treatment. Overall, the current experimental approach can be employed to study the mechanism of electrochemical events that are occurring on metallic interconnections in different electronic devices.

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