

## Feasibility Project

### Challenges for electronic manufacturing posed by new surface contamination related failure modes in the context of the wireless revolution.

*Partners: Loughborough University, Henkel Technologies*

The past decade has seen exponential growth in the market volume of wireless enabled products, offering functions such as data transfer, computer connectivity, remote sensing and AIDC (auto-identification and data capture). The UK electronics manufacturing sector is poised to benefit substantially from future growth in these and other emerging RF communications based sectors. Wireless products demand high impedances from circuit board materials and insulation, but at the same time due to their mobile nature see wider ranges of environmental conditions than products designed for fixed locations. In order to protect the circuit impedance against degradation due to environmental contamination, conformal coatings are frequently used. At the same time as the wireless market has expanded, assembly processes using so called “no-clean” flux based solder pastes have been widely adopted in order to reduce the use of environmentally damaging cleaning solvents.

There is anecdotal evidence of unexpected failure modes in conformally coated wireless products assembled with these no-clean or low-solids solder pastes. No-clean processed wireless product circuit board assemblies must in fact often be cleaned if a conformal coating is to be applied, but normal cleanliness level assessment techniques based on determining concentrations of soluble ionic species on the board surface cannot detect ionic species trapped under films of no-clean solder paste organic residues. A failure pathology is suggested in which an inadequate cleaning process results in trapped ionic contamination. In the field, water vapour diffuses through the conformal coating and interacts with the trapped ionic contamination. In sensitive locations a leakage path, sometimes called a low impedance short, may form, causing a subtle degradation in performance or reduced battery lifetime of a wireless product. If failure is not outright the underlying causes of the degradation in performance may never be recognised.

This project will aim to reliably reproduce such failure mechanisms under controlled conditions. Failure will be correlated with X-ray photoelectron spectroscopy (XPS) measurements of the levels and locations of organic and ionic contamination. In addition a set of structured experiments will confirm the exact mechanisms linking failure with this combination of contaminants.

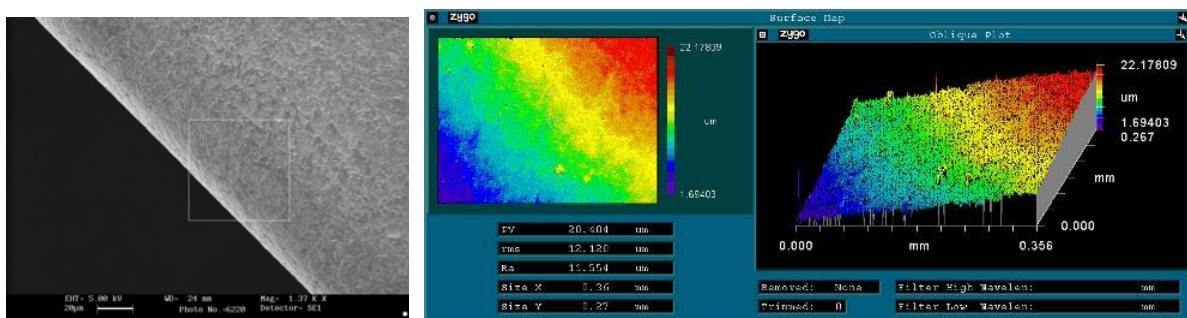


Figure 1. X7R capacitor surface characterisation. Left: SEM image. Right: surface profile.

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