RDL – Bond Pad Redistribution Layers

What do you do if the designers of a chip placed the bond pads in a poor location for your application? Perhaps the bond pads are located down the middle of the die to allow for faster access, but you need them around the outside perimeter like the last generation. Maybe the chip was designed for wire bonded surface mount, but you need solder bumps and flip chip mounting. The answer is RDL or Redistribution Layer.

There are three primary uses for RDL. The first is to move the bond pads around the face of the die for flip-chip applications. It is important to spread the contact points around the die so that solder balls can be applied and the stress of mounting can be spread. Another important application of RDL involves die stacking. In this application, similar die can be mounted in a single package. In order to give each die a unique address, the address lines of each die can be placed in a unique location. A third application for RDL is simply to move the bond pads of a device to a position more convenient or accessible for subsequent bonding and packaging steps. This may include matching the layout of an old die that is no longer being supported and must be replaced by a newer design.

How is RDL accomplished? RDL is a process that generally involves one or two layers of metal and two or three layers of a polymer dielectric material such as polyimide or BCB. Process steps are described below:

![Diagram](image1)

**Fig 1** – Die cross-section showing original bond pad location and glass passivation.

![Diagram](image2)

**Fig 2** – Polyimide dielectric layer is deposited and patterned to open bond pads while sealing fuse openings.
Fig 3 – Conductive metal layer connects old bond pad to new pad location.

Fig 4 – Second layer of polyimide protects the metal trace. New bond pad location is opened up.

Fig 5 – Solder bump or wire bond can be attached in the usual way.

Fig 6 – Photo showing old bond pad locations, RDL and solder bumps.

(Above images courtesy of George A. Riley, PhD, FlipChips Dot Com)
How can Yield Engineering Systems (YES) help with my process? YES builds several pieces of equipment that are particularly suited for RDL processing.

Central to the RDL process is the curing of the polymer dielectric. YES polyimide curing systems, such as the YES-PB and YES-VertaCure Series tools, have several distinct advantages over conventional baking systems.

First, YES uses a series of vacuum / N\textsubscript{2} cycles to create an oxygen-free environment for the curing. Incorporation of oxygen in the polyimide can lead to a dark brittle film. YES ensures an environment of less than 10 ppm of O\textsubscript{2} before heating the substrates, leading to a stronger polyimide film.

Second, YES cures at partial vacuum. The vacuum draws the solvent out of the film of polymer leading to a faster more complete cure. During the curing process, the system flows a low volume of filtered nitrogen which pulls the solvent away from the substrates and helps remove particulates. Programmed temperatures with controlled ramp rates lead to low stress films. This is especially critical when employing multiple layers of polyimide. After the first metallization layer, temperature control of the cure is even more important. Improper curing can lead to the first polyimide layer softening and wrinkling the metal traces due to imparted stress.

The YES-1224P Vapor Deposition System is designed to accommodate the wide variety of processing needs likely to be encountered in an RDL process environment. The efficient use of chemical allows coatings using as little as 100ul of chemical. At the same time, the 18x18x16 chamber can accommodate large or oddly shaped substrates or larger numbers of substrates in a pre-production mode.

From a process standpoint, the plasma system can be setup to run processes from very gentle downstream cleans to more aggressive Active or ion trap modes. Gases used range from inert gases such as argon or helium for surface activation to oxidizers and reducers such as oxygen, CF\textsubscript{4}, ammonia or forming gas for cleaning or etching application.

The vapor deposition portion of the system can use silanes ranging from non-reactive adhesion promoting coatings such as HMDS to alkyl silanes such as OTS to more reactive chemistries such as amines, acrylates or epoxies. For anti-stiction applications, fluorinated silanes can be used.

The linked recipes allow the user to easily go from plasma surface preparation to hydration to deposition without breaking vacuum. The linking also allows for sequential deposition, reacting one silane with another or passivating the chemistry at the end of the deposition with a reducing plasma to ensure a known surface.
The YES-CV200RFS is a unique plasma processing system capable of gentle resist descum or more aggressive resist or polyimide strip and etch processes. The downstream plasma ensures electron-free processing, while the built-in hot plate ensures repeatable etch rates. Recipe management via PLC (Programmed Logic Controller) ensures the operators will be using the same conditions from run to run with simple selection commands.

YES-CV200RFS

Unique features of the YES-CV200RFS Plasma System include:

A. Downstream RF plasma
B. Substrate Hot Plate allows controlled processing temperature from 50-250°C
C. Rapid heating cycle to allow loading at low temperature and processing at raised temperature.
D. User selectable 4 process gases
E. Chamber purge cycles for flushing process by-products
F. Cool-down cycle for safe substrate removal at end of process
G. Manual load and unload can accommodate 2-8” substrates or odd size individual pieces

Contact Us

YES has been designing and manufacturing innovative process equipment since 1980.

When you are ready to run process tests, just let us know – a demo can be arranged using your chemicals and samples. Call +1 925-373-8353 (worldwide) or 1-888-YES-3637 (US toll free).