PR:1804	Client:: Teknek
Status: 1st draft	Date: 31 July 2008
Publication: Global Solar Technology	Deadline:
Cover Date: September 08	Word Count: 941 words
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FEATURE ARTICLE

Combating the impact of contamination in solar cell production

By Sheila Hamilton, Technical Director, Teknek

Photo voltaic cell manufacturers today are under increasing pressure to increase yields and improve the efficiency of their products. This has become more imperative as the cost of raw materials has risen dramatically in recent years. One of the main barriers to achieving this is the incidence of contamination in the production environment. If contamination is present before coating, metallization, printing or lamination yields may be affected.

This article will look at the impact of contamination, the key sources of contamination and the problems which can arise and suggests possible solutions to negate the effects of contamination.

How contamination affects PV module production depends on which of the three types of solar cell being produced.

In first generation solar cells – silicon wafers – the presence of dirt and debris of collector circuits can affect the screen printing process leading to problems such as tomstoning, pin holes, open and short circuits. Contamination of solder joints can lead to miniature 'blow outs' as organic materials vaporize and expand rapidly causing voids and dry joints.

The solar cell modules are then encapsulated in an EVA film. If dust or particles become trapped between the film and solar cells it can affect the efficiency of the cells by blocking sunlight. Given that efficiencies are already generally low this is something manufacturers will wish to avoid. Even particles too small to be seen, due to a tenting effect, can produce visible defects in the laminated surface (fish eyes).

The second generation of PV cells – vacuum metalised – are more efficient however the substrate needs to be cleaned before and during the deposition chamber process. In addition, the connector circuits face similar problems to first generation PV cells in terms of tombstoning, blow-outs and short circuits if contamination is present. Likewise, at the encapsulation stage the glass or film must be cleaned if maximum efficiency is to be achieved.

Third generation solar cells use screen printing techniques similar to those employed in the microelectronics sector. This type of cell generally has a lower efficiency than generations one and two so it is important that contamination does not lower the efficiency even more. The substrate and stencil must therefore be thoroughly cleaned before each printing stage. As the collector patterns become ever finer to produce greater efficiencies the impact of particles becomes greater. The substrate used for printing is generally polyester film or thin sheet steel. These substrates arrive for coating or deposition direct from the supplier and are frequently contaminated with debris from the manufacturing process. For example, rolls of polyester are usually slit to a specific width and slitter dust can be present on the surface of the material. Statically attracted particles are also an issue for dielectric base materials.

It is not only during the manufacturing process that contamination can cause problems. Conductive materials (debris) can result in corrosion of the finished product and may only show up in the field later in the product's life.

So what can be done to minimise the impact of contamination in a PV cell production environment? Many manufacturers are turning to a proven technology from the semi-conductor sector – contact cleaning.

Using contact cleaning equipment it is possible to remove loose particles down to one micron in size from a silicon wafer or substrate such as glass or EVA film without damaging the surface. The equipment, pioneered by Teknek, uses a special elastomer roller to lift the contamination from the surface which is then transferred to a roll of adhesive film for examination and disposal of the debris. When used at each stage of the production process where contamination could be present, contact cleaning equipment can lead to dramatic increases in yields and the efficiency of the PV cell. Contact cleaning methods have proven to be the most effective means of removing contamination as the roller makes contact with the surface. Other methods such as blowers and vacuum systems cannot cut through the boundary layer of air which sits just above the surface of the substrate.

A variety of standard and bespoke contact cleaning equipment is available to suit most PV production environments for both in line (continuous/reel to reel) processing and discreet items such as wafers.

Conclusions

With the costs of raw materials rising it is more important than ever for PV manufacturers to find ways of increasing yield and reducing waste. Contamination has a major impact on both production efficiency and efficiency of the solar cells themselves. By removing contamination using methods such as contact cleaning it is possible to increase yields and improve the efficiency of solar cells.

For further information please visit www.teknek.com

<Insert case study?>

About the author:

Sheila Hamilton is technical director and a board director of Teknek and is responsible for keeping the company at the forefront of its field in terms of innovation and product design. Sheila joined Teknek in 1987 as technical director after working as a product designer (yachting equipment) and power station engineer. She has also run her own consultancy in the field of electronics component packaging. Sheila has a BSc in Mechanical Engineering from Glasgow University and is currently studying for an MBA at Strathclyde University. In addition, she is a recipient of two Smart Awards in the field of Electromagnetic Interference.

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