Fuel Cell

Frequently Asked Questions

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As environment-conscious consumers clamour for alternative energy technologies to be ready now, the time is right for fuel cell projects worldwide which span a wide range of applications and power levels - to step out of the laboratory and into mass usage. Manufacturers now need high-speed production techniques and efficient, controllable processes, to create large numbers of fuel cells at a cost-effective unit price. DEK has already developed a series of processes and products suitable for use with the leading fuel cell technologies.

What components can DEK's processes help to produce?

DEK has developed precision screen printing processes to address the requirements for coating the structures that separate the fuel and oxidant and promote ion exchange between the two. Depending on the fuel cell technology employed, this may be an electrolyte layer created as a unit with the electrode, or a separate membrane coated with the ion exchange material.

What fuel cell technologies is DEK able to support?

DEK has successfully developed process solutions to create the ionomeric polymer membranes used in many fuel cell types including those using direct or reformed methanol or ethanol, proton exchange fuel cells and reversible fuel cells. We have also demonstrated successful process solutions for solid oxide fuel cell technology.

What is the benefit of using a screen printing process?

There are several benefits, which ultimately reduce the cost per fuel cell and thereby enable economic power generation in terms of price per kiloWatt. For example, screen printing significantly reduces wastage of the expensive, platinum-bearing electrolyte materials, allowing much more effective control of manufacturing costs compared to traditional spraying or vapour deposition techniques. Screen printing is also more accurate and repeatable than spraying or vapour deposition.

How closely can the deposit thickness be controlled?

Screen printing can achieve deposits with total thickness variation less than 10%, which is well within the requirements for membrane-type or solid oxide fuel cells. Deposits can also be positioned accurately in the x-y plane, to within ±20 micron, and complex shapes can be created if desired. This is difficult to achieve with vapour deposition, for example. Moreover, the very high process control and repeatability of the process virtually eliminate instances of voids or pin holes, which can induce catastrophic failure of a membrane-type fuel cell. In addition, DEK has developed verification systems to detect the presence of any such defects and to verify uniform thickness. Screen printing will only produce voids or pin-holes if the process is allowed to drift beyond limits, through inadequate process control or poor maintenance.

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Can screen printing achieve high throughput for commercial production?

High throughput is one of the major advantages of screen printing; large numbers of components can be produced quickly, without impairing process control. The standard printable area of a suitable screen printer such as the DEK Europa is 510mm x 518mm, which allows a large area of raw membrane or electrode material to be coated quickly – effectively producing many units simultaneously. Moreover, the high level of automation incorporated into the Europa platform enables a very fast cycle time, currently about seven seconds, allowing successive substrates to be produced at a very high rate of throughput. One of our targets for development is to reduce the cycle time to five seconds, which will allow production of fuel cell components to become even more cost-effective.

It is important to note that this high-speed operation is combined with very high process repeatability, maximising the number of "good units" produced per hour; this is the figure of merit that truly defines the throughput of a process.

How can faster cycle time be achieved?

DEK has introduced many solutions for surface mount electronic assembly, which have delivered valuable savings in cycle time. We are working to develop the benefits of these techniques within the alternative energy domain. For example, DEK's high-speed machine vision systems minimise the time required to align any substrate as it enters the machine prior to printing. These systems are already an integral part of DEK's fuel cell process solutions, delivering effective savings in the core cycle time of the process. Another example is the DEK Rapid Transit Conveyor, which increases the transit speed of each substrate into and out of the printer. We have also successfully applied the DEK Fluid Print System to fuel cell manufacture, which results in a more time-efficient printing sequence and also preserves the condition of the printing medium to prevent deterioration through excessive exposure to ambient conditions before being printed.

What equipment is required?

DEK has developed successful membrane coating and solid oxide electrode production processes using the DEK Europa screen printer and precision emulsion screens produced under class 10,000 clean room conditions at our dedicated screens facility in Weymouth. We have also developed special handling mechanisms and tooling that are specific to fuel cell applications, as well as the innovative inspection techniques to verify satisfactory coating. Completed process are in operation today, using either standard screen printing squeegees or an enclosed print head with pressurised storage chamber, developed using DEK's patented ProFlow® technology.

What customers does DEK have for its fuel cell solutions?

It is not possible at this stage to disclose the names of customers. DEK has successfully implemented screen printing processes as part of major fuel cell programs in Europe, Asia and North America, and we are currently working on several new fuel cell projects with other partners who are well-known brands. We expect DEK screen printing solutions to be the chosen membrane and electrode manufacturing processes in the majority of fuel cell technologies that will be achieving market readiness in the near future.

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