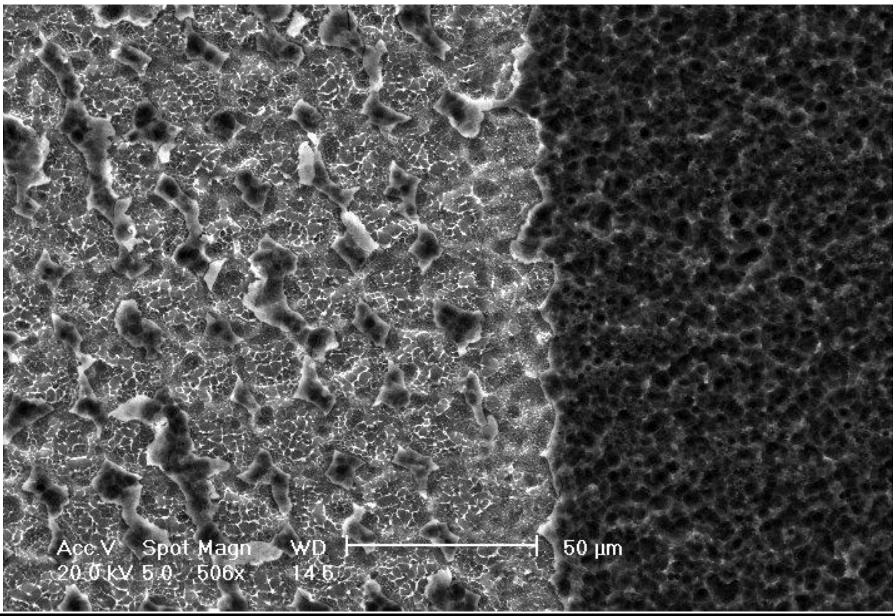
Technology White Paper - Miracle Plate

Ultra fast laser exposure switching aluminium oxide from hydrophobic to hydrophilic



CTP using blank plates

The most important technology breakthrough since the introduction of thermal CtP

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Technology White Paper

This document describes the technology and science behind the 'Miracle Plate' technology which has been created and patented by JPI. JPI is a science company founded by three highly experienced graphic arts executives:

Dr Rod Potts. Former R&D Director for Lithographic Printing Plates at DuPont & Agfa

Dr Peter Bennett. Former R&D Director for Lithographic Printing Plates at Kodak

Mr John Adamson. Former plate Manufacturing Manager at DuPont & Agfa

Introduction and summary.

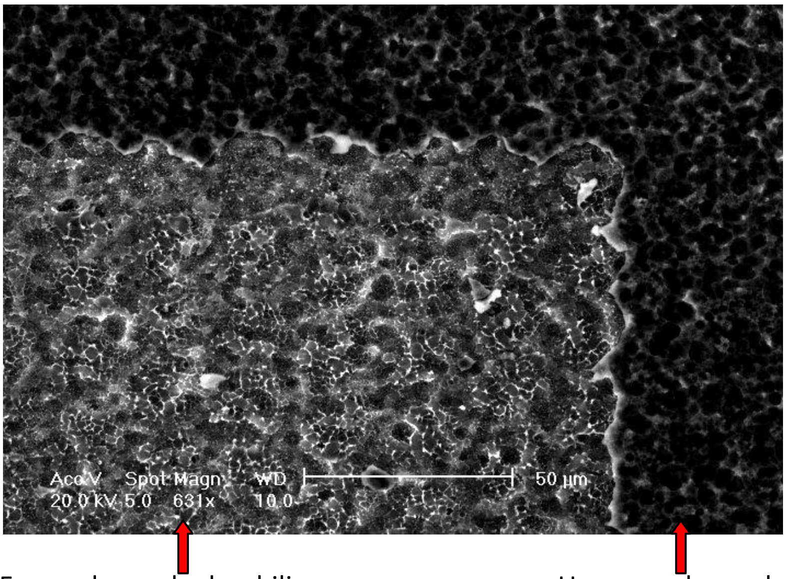
JPI formed with the purpose of combining the R&D expertise of the former Kodak and Agfa R&D leaders in order to create a novel lithographic plate technology that would make a significant technical and environmental contribution to the printing plate industry. After several years of research and collaboration with leading Universities and partial funding from the UK Government, JPI have sought patent protection on a method of laser exposure on uncoated standard grained/anodised aluminium that allowed uncoated aluminium to switch from its normal (oxidised) hydrophobic state into a hydrophilic state.

Uncoated grained and anodised aluminium will quickly and permanently switch from hydrophilic (at the point of manufacture) to hydrophobic after a few days exposure to the atmosphere unless it is gummed. JPI have been able to switch the hydrophobic uncoated alumina surface back to a hydrophilic state using ultra fast laser pulsing to temporarily hydrophilise the aluminium surface. It does this by modifying the surface of the alumina, which creates highly hydrophilic species. The imaged area is visible as a darker coloured area under normal viewing conditions and as a physically modified area under magnification; on the printing press the plate performs in a similar fashion to a normal printing plate. The imaged areas take fount and the non image areas take ink. The plate prints for several thousand copies, the exact run length has not yet been determined. After printing the plate can be cleaned of ink with a standard plate cleaner and returned into the normal hydrophobic state in a variety of ways, for example, by allowing to 'stand' under normal atmospheric conditions for 1-2 days or by simply heating the plate for a few minutes under moderate temperatures. The plate can then be re-imaged and re-used - JPI has demonstrated that at least 5 're-use' cycles are possible.

The benefit to the lithographic plate industry is the potential elimination of all the chemicals in the plate coating, organic solvents from the coating process as well as all requirements for processing equipment and the associated processing chemistry. In 're-use' mode, savings on transportation and packaging are significant both economically and environmentally.

The technology is described in complete detail in patent applications GB 0816697.7 and GB 0910791.3

The photomicrograph, below, shows a freshly laser exposed plate. The plate was a typical 'blank' – uncoated grained and anodised aluminium. In the light coloured region, exposure has modified the alumina surface creating a hydrophilic area. The unexposed, darker coloured (in this SEM photo), area remains hydrophobic.



Exposed area, hydrophilic

Unexposed area, hydrophobic

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Technology Description.

Research using the latest ultra-fast lasers, typically operating with a frequency of 1kHz+, 30µ spot size, pulse width 240 femtoseconds and with an energy density (fluence) of around 225 mJ/cm^2 has shown that the lasers temporarily change the contact angle between the aluminium surface and water. Specifically, the normal contact angle of 70° is changed to 20° and this new hydrophilic state remains for 12 hours before gradually returning to normal around 12-24 hours after exposure. Using other substrates such as titania gives a similar result, though with a faster reversion back to hydrophobicity over 5 hours. This suggests that the technology is capable of fine-tuning to give the required specifications.

Laser pulsing has been shown to be most effective when pulse duration is at least 1×10^{-15} seconds and no greater than 1×10^{-12} seconds.

Much of the work has been done at Liverpool University, England. Liverpool's Lairdside Laser Engineering Centre is regarded as a resource of international importance with state of the art high power laser equipment for the research and industrial development of welding, cutting, marking, surface treatments and novel laser based processes.

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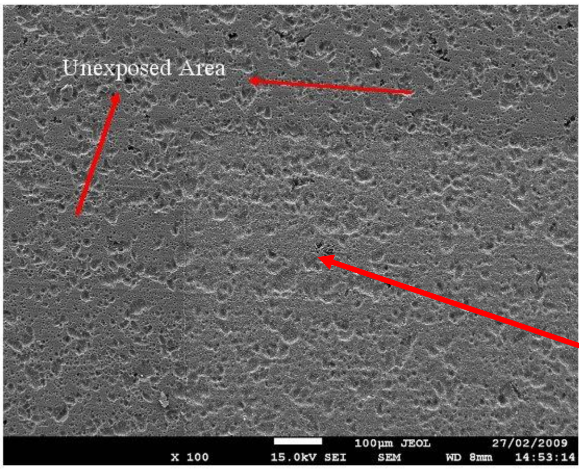
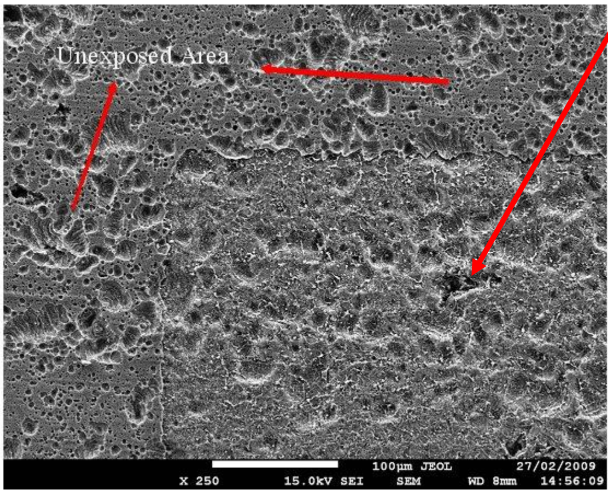
There is a visible change on exposure and this change is also apparent as a slight observable difference via Scanning Electron Microscopy (SEM) as is evidenced in the micrographs below.



Laser exposed inner area

Above and below: Partially exposed blank aluminium printing plate



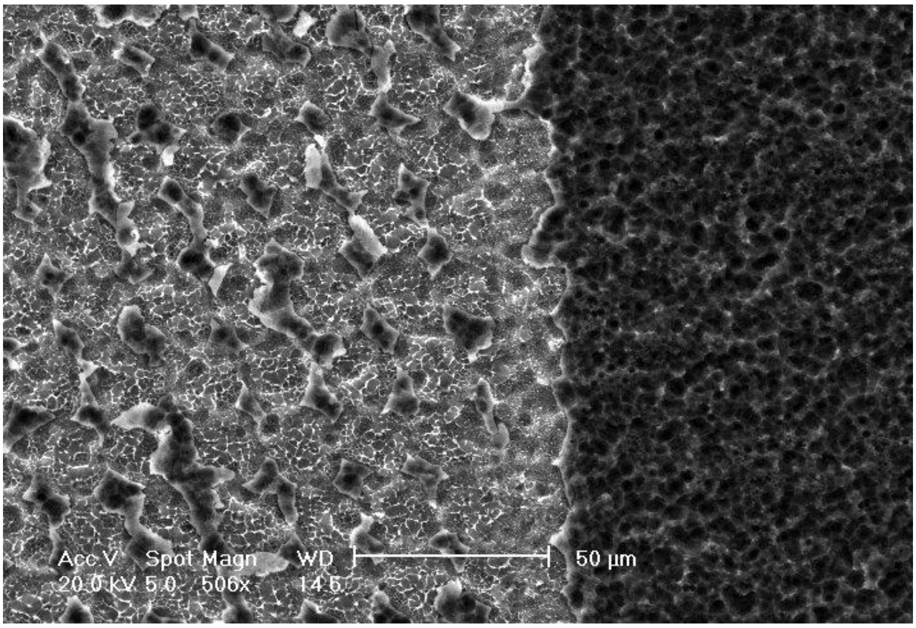


Image - above, shows a further photomicrograph of the surface of a laser exposed (grained and anodised) aluminium plate. The light coloured area (left) is exposed and hydrophilised. The darker coloured area on the right is unexposed and hydrophobic.

The photomicrograph, above, shows changes to the surface following laser exposure.

The laser itself can physically and potentially chemically, modify the anodic/graining structure particularly so when very high laser energies are used. In order to minimise the risk of over/under exposure a 'top hat' laser profile is preferred for exposure rather than a normal 'gaussian' beam profile.

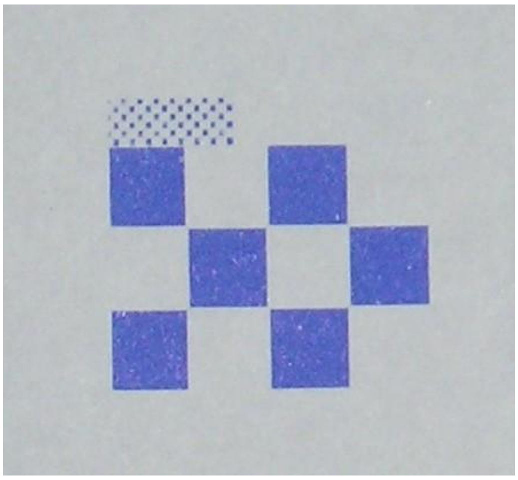
Miracle Plate – after exposure.

After exposure, the plate shows a physical surface change as the alumina changes in state from hydrophobic to hydrophilic. This changed state is easily shown using water contact angles measured over a period of several hours.

Time after exposure	5 mins	1 hour	4 hours	12 hours	16 hours	18 hours
Contact angle	20°	20°	20°	30°	55°	70°

This indicates that an exposed plate could be printed at any period within 12 hours of exposure. Of course, it is likely that further optimisations of substrate would either increase or decrease the timing mechanism. JPI has had only limited resources and further work is needed to characterise the different substrate variables such as post anodic treatments and electrochemical graining/anodising criteria. Such process optimisation could also yield important press performance criteria.

The imaged plate is printed in exactly the same way as any other lithographic plate. No special press, paper, ink or handling requirements are necessary.



Above - photo of print sample from Miracle Plate

Miracle Plate – The Future

The Miracle Plate technology has demonstrated a unique concept – that of switching an uncoated litho ‘blank’ plate from hydrophobic to hydrophilic. No coating is necessary with huge financial and environmental savings to the printing industry. The technology is robust and can be used on press with no changes to pressroom practices. The technology could be used in either of 2 ways:

a) Use once. The uncoated blank is imaged and printed and the plate can be re-cycled in the normal way.
Or

b) Use several times. If the ink is removed after printing and the plate allowed to revert to its hydrophobic state (either naturally or by heating) it could be re-imaged and then the whole process repeated. The technical challenge would be re-imaging a plate which has been bent for press mounting. However, there would be technical solutions to this, such as having matched clamping systems on both the printing press and the platesetter. Another option is a re-usable printing ‘cylinder’ which would slide on and off the press and into a platesetter system equipped with the pulsing laser. The printing cylinder would be grained and anodised and could be re-imaged and re-used for several print jobs. This could dramatically reduce aluminium plate consumption. With many presses now incorporating auto ‘wash’ cycles to remove ink, the concept of a re-usable printing sleeve has some very attractive environmental and cost benefits. The ‘sleeve’ concept could be applied to a new range of miracle-enabled presses or retrofitted to existing presses.

The technology continues to be developed by JPI who are looking for ways to bring this technology to the mainstream print market