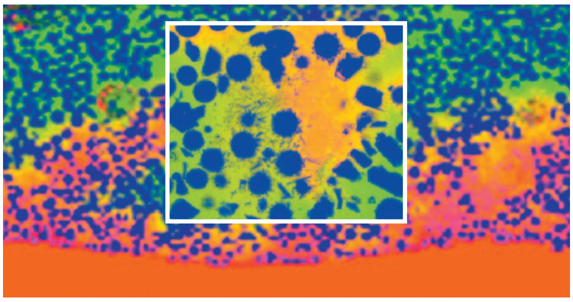
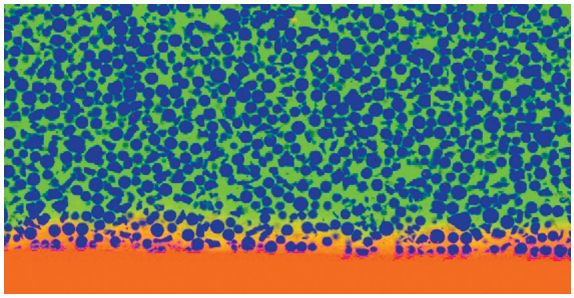
Why use laser cladding?

An improved laser cladding deposition process developed by ADIA Member LaserBond Limited is proving far superior in extending wear life for tools, machinery components and wear parts across a vast range of industries and applications. This paper, written by Greg Hooper, Executive Director and Founder of the company, summarises the differences and advantages of the laser cladding process.



Normal Laser Cladding of composite layers produces undesirable dilution and decarburization of the carbide phase, thus reducing performance.[#]



New patented* LaserBond® deposition technology provides a metallurgical bond without the debilitating dilution effects, and enables the deposition of layers with a higher concentration of retained hard phases.[#]

Our innovative laser powered cladding process.

The LaserBond® deposition process is a surface engineering process. It enables the deposition of metallic or metal matrix composite (MMC) layers with a full metallurgical bond, utilising an accurately focused and infinitely controllable high power laser beam, enabling precise control of the heat transfer into the base material and the deposited layer. It enables temperature sensitive components and materials, such as hardened shafts and gears, to be repaired with minimal risk of distortion or other undesirable heat effects that undermine the integrity of the component or in-service performance.

The use of manual arc welding and Plasma Transfer Arc (PTA) processes to deposit metal and metal matrix composite (MMC) overlays with carbides has been in wide use for many decades.

There are two significant problems when depositing tungsten carbide (WC) overlays with these methods. First, the decarburization and dissolution of the WC due to excessive heat. Secondly, relatively high dilution levels require the deposition of multiple layers to achieve the required chemistry.

Decarburization and dissolution are the tell-tale signs of excessive heating of the WC during deposition, and can cause a significant deleterious effect on the wear resistance of the deposited layer.

Because of the high heat imposed on the WC by these processes, the WC is usually limited to particle sizes larger than 75um, most often 125um to combat decarburisation and dissolution.

PTA and the more recent HP-HVOF process are less expensive and very suitable for many end use applications, however they rely on a mechanical bond. The MMC's deposited by these processes have been widely used and accepted because they were the best available at the time and they delivered better performance than an unprotected component.

Greg Hooper, Executive Director and Founder of LaserBond Limited.

The use of lasers for materials processing and in particular laser cladding, is a relatively new development. LaserBond first trialled lasers in 1999, building one of the world's first high powdered laser cladding systems in 2002. Laser cladding has received significant attention and development in recent years due to its unique features and capabilities in various industries involved in metallic coating, high value component repair, prototyping, and low volume manufacturing.

Utilising a laser to deposit tungsten carbide MMC overlay enables the deposition of significantly smaller WC particles, with minimal heat effects evident. Therefore, concentration of WC can be increased significantly, the mean free path between the WC particles is smaller, and the wear resistance is considerably improved.

Game changing technology

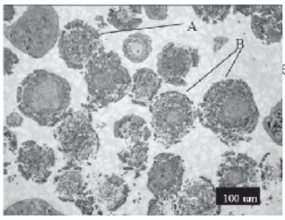
The 'mean free path' is the critical parameter as it's the metal matrix material (cobalt, nickel or similar) that wears - not the tungsten carbide. The smaller the average size and the higher the volume percentage of WC particles within a deposited layer delivers its abrasive and erosive wear resistance.

The metallurgical bond allows applied layers to be used in high impact, heavily loaded situations with no risk of spalling or separation of the overlay. The infinite controllability of the laser energy allows minimisation of undesirable thermal decomposition of hard phases such as carbides, resulting in optimum wear resistance.

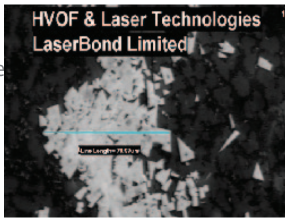
Due to the extremely low dilution with the substrate, thin layers of high performance corrosion and wear resistant materials can be applied. High performance layers from 0.3mm are possible. Thick overlays for significant repairs of up to 20mm can also be applied in multiple passes.

These advantages are especially important when depositing wear resistant composite layers such as tungsten carbide. A very hard, dense compound of tungsten and carbon. With high hardness (2200 to 3000 VH) and its high melting temperature (2870°C) it is the material of choice for MMC overlays deposited to thwart premature failure of machine parts subjected to severe erosive and or abrasive operating environments.

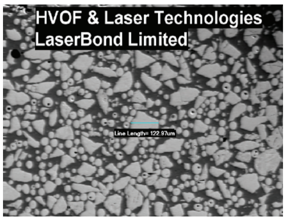
The micrographs of PTA and Laser deposited MMC's, visually demonstrate the quality differences of each of the processes.



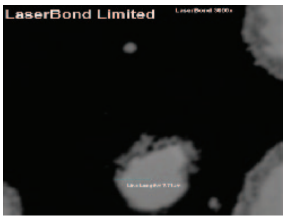
Micrograph 1
This micrograph of PTA deposited spherical WC in a Ni alloy, shows decarburization of the WC particles. The decarburization can be seen as the hallo effect around the WC particles.



Micrograph 2
PTA deposited WC overlay showing near total destruction of large WC particle through decarburization.



Micrograph 3
Laser Clad deposit of spherical and angular WC in a Ni alloy matrix. The WC is evenly distributed with no decarburization evident.



Micrograph 4
WC particles as small as 10µm can be deposited via the Laser cladding process with minimal decarburization.

LaserBond has a continuous research and development program to ensure application methods and metallurgy work together. To facilitate these developments, the company invested in their own in-house laboratory to carry out testing and examination, including metallographic characterisation, hardness testing and chemical analysis.

One of the main tools for this research is their SEM – Scanning Electron Microscope, which allows for investigation of coatings and metallurgy down to the Nano scale. The lab is routinely used for the optimisation of coatings and overlays, quality control of incoming materials, reports to clients on new applications and materials and failure analysis as required. Routine examination of the effects on substrate metallurgy of the coating and bonding of the cladding operation ensures component integrity or properties are not compromised.

Leading up to 2014 LaserBond discovered a new laser deposition method which elevated performance opportunities still further. Recent synchrotron images shown top left illustrate the results of LaserBond's new deposition technology which has created opportunities for redesigning high wear components.

Their new LBH Down-the-Hole hammer was a perfect application. Comprehensive independent tests proved extended wear-life by 305% and a 7.5% reduction in total drilling costs.

The new LaserBond® cladding has proven advantages over previous methods

1. High deposition rates with infinitely variable energy adjustment.

2. Extremely low dilution with base material enabling very thin layers.

3. Almost non-existent heat affected zones, thereby no effect on structural performance of substrate.

4. Negligible distortion, enabling cladding of dimensionally sensitive components.

The company's knowledge of the cladding process, associated metallurgy and its end use application environment allows it to offer a 12 month warranty / guarantee for laser cladding work and a zero risk trial for their DTH Hammers.

* International Patent Applications apply # Australian Synchrotron Images

PRODUCTIVITY | INNOVATION | CONSERVATION

Three times longer life, 7.5% total drilling cost savings, and increased penetration rates were the key findings from this independent DTH hammer trial.

Faster drilling, slower wear and fewer change-outs result in lower drilling costs.

Since the initial 2015 comparative DTH Hammer drill trial in Queensland, our new LaserBond cladded drill hammers have been put to the test in various ore bodies and ground conditions around Australia and overseas.

Drilling contractors and miners have been keen to explore whether the improvements in wear-life and cost reductions delivered at that first trial can be replicated on their sites.

And it appears that is exactly what's happening.

In fact one drilling contractor commented that not only was wear-life significantly improved but the drill holes were being drilled faster – even further cutting costs.

With our ongoing collaboration with customers we're continuing to develop our game-changing LaserBond DTH Hammer drills so we can confidently offer a superior, reliable product with the certainty that it will deliver faster drill holes, longer wear-life and seriously lower overall drilling costs. Find out more at: www.laserbond.com.au/hammertrial

Just pick up the phone or email us now to arrange your own risk free trial.

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