TECHNICAL REPORT

I-CAR NEW ZEALAND

ADHESIVE BONDING:

THE END OF WELDING IN AUTOBODY STRUCTURES?

Probably not in the foreseeable future, but at the same time, adhesives are being utilised in more and more locations on the unibody by virtually all vehicle manufacturers.
With the recent advancements in autobody technologies and in particular, the mixing of dissimilar, high-tensile strength materials, there are many challenges facing vehicle manufacturers and their associated component manufacturers.

This article is an in-depth look at an emerging technology for attaching parts together, and if the hype is to be believed, will tick all the boxes that relate to speed of assembly / cycle time / recyclability / sustainability / consistency of performance and durability. What will be of real benefit to the collision repair industry, where traditionally most technical advancements have created less opportunities for repairs, is the fact this is a product that can be RE-USED.

This emerging technology is an adhesive that has simply been labelled Magic Car Glue – that may sound a little like something you would find in a child's school science project, but the proper description certainly brings this into the 21st century…

The full description is :
Ferro – Magnetic – Nano – Particle - Electro – Magnetic glue - Quite a mouthful !!! - As with many advancements and technologies in automotive applications , this has been abbreviated to FMNP (Ferro-Magnetic–Nano-Particles). This material has been developed from a joint venture between the American Chemical Council (ACC) & the Michigan State University (MSU), as well as input from

the Centre for Automotive Research (CAR). It is entirely suitable for joining metal to metal (all types of steels and aluminiums), metal to composite & composite to composite.

Traditional bonding methods are not the ideal solution for vehicle assembly as they are normally a permanent fixture, unable to be disassembled or adjusted, and are slow to cure. Additionally, most adhesive applications also require the use of some other fixing(s) to provide the appropriate peel strength (in general terms, adhesives have good shear strength only). Weld – bonding has been utilised extensively by OEM's to solve this problem, but is often not able to be utilised for AHSS steel parts and is completely unsuitable for joining dissimilar materials together (steel to composite, for instance).

Traditional mechanical fixings, such as rivets, screws, bolts, clamps and clips add substantial weight, while punching or drilling holes for fixing can compromise the structural integrity of a joint (especially in composites), and create possible stress / fatigue points over time.

The global standard on vehicle assembly lines for creating a body joint runs at under sixty seconds! – a hard act to follow when using adhesives, as most, if not all gluing operations take far longer than this (preparation, application, clamping and in particular, the curing process).

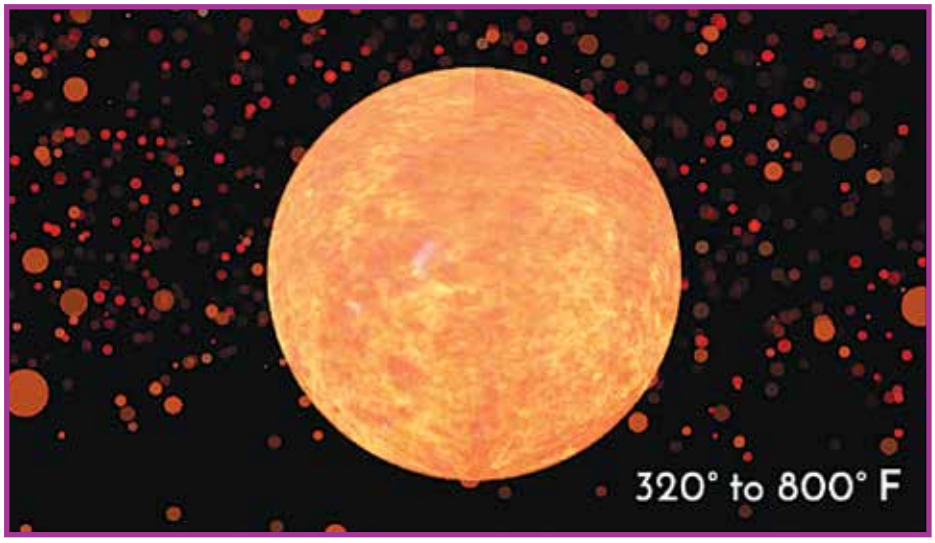
Effectively, FMNP solves the curing issues by changing the physical properties of the glue. By doing this, the joint is HEATED, a strong BOND is created, and then COOLED/SET in under a minute – So, how does this happen?

By necessity, this does become a little complicated – essentially, Magic Glue is nano-sized (atomic sized) iron particles in the shape of spheres, inside a polymer (plastic). These spheres look like dust when mixed into the glue.

When these spheres are subjected to AC (Alternating Current), the magnetic field is changed and the spheres vibrate rapidly – this action creates FRICTION and FRICTION generates HEAT – almost instantly (320 - 800 degrees Fahrenheit or 160 – 425 degrees Celsius). This instant heating has very little migration into the joint area, so is seen as being highly suitable for heat-sensitive metals, and virtually eliminates the need for clamping.

Further to this, the heated nano -particles give off energy that creates a crystalline structure in the adhesive – more crystalline polymers have better strength.

Super - heated nano particles magnified -



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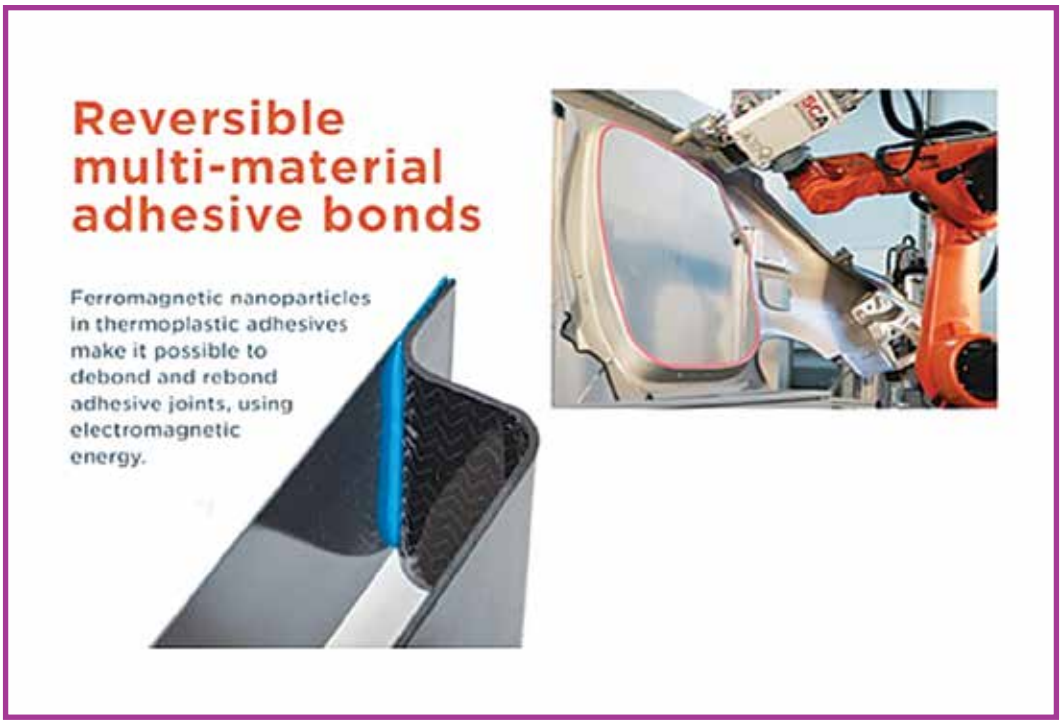
This is an obvious advantage to vehicle-makers for their assembly times, and dissimilar material joining requirements, but also has major advantages in the collision repair industry. Magic Glue is a material that can be bonded, unbonded and re-bonded – almost instantly!! – simply by heating electronically.

This allows for damaged parts to be replaced without interfering or compromising adjacent components, or affecting the joint substrates. What's more, research and testing has identified that re-bonded joints can be up to 40% stronger .

Effectively, many of the traditional processes required when working with adhesives in body repairs (as listed below), can be by-passed –

- **Careful, slow heating to separate joints.**
- **Removal and cleaning up of all remaining adhesive materials**
- **Substantial substrate preparation**
- **Observing wet/work and clamping times.**
- **Extended curing times in controlled environments.**

It would be fair to say that if OEM's embrace this technology, it will have substantial benefits for the collision repair industry also – that would include increased repair opportunities with cost savings, and by being more environmentally friendly (recyclability).



These articles have been written by Martyn Lane : I-CAR Instructor, Weld Test Administrator and Technical Specialist to the auto body industry

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