Ultrasonic supported Resistant Spot Welding for Metal-Plastic Composites

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Metal-plastic composites (MPCs) show benefits for different applications. A challenge that links all these applications is the necessity to process the MPCs efficiently with high quality and to join them with other materials, using suitable joining techniques. Due to the polymer core layer, joining is one of the most critical challenges for processing MPCs [1]. The core must be heated quickly for expulsion out of the future welding zone and this without extensive process modifications. For that in contrast to conventional solutions the polymer layer's local melting is realized by ultrasonic (US) waves. The main advantage of this technique is that energy is directly coupled into the polymer layer [2]. For this purpose, a hybrid spot welding gun was developed to melt the polymer core of the MPC by ultrasonic waves and subsequently join the MPC with another metallic sheet by resistance spot welding (RSW) in one single process step (Figure 1 a)).

The MPC material discussed in this contribution is LITECOR®. This MPC consists of two thin galvanised steel sheets of 0.3 mm thick and a 0.6 mm thermoplastic (PA/PE compound) core layer. In the studies carried out, LITECOR® was joined with a 0.8 mm thick DP600 steel.

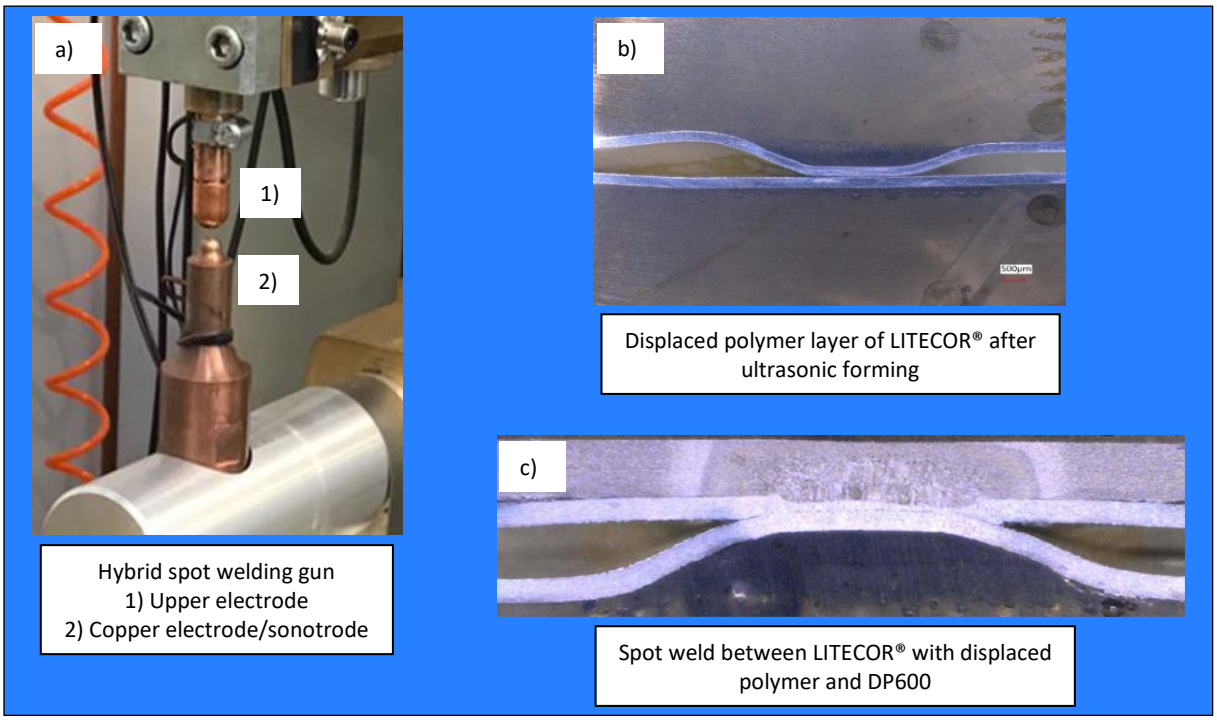

Figure 1. a) Hybrid spot weld gun, b) Ultrasonic forming process of LITECOR®, c) Spot weld between LITECOR® and DP600

By means of experiments and FE simulations the ultrasonic forming process was optimised. For this purpose, a special incremental FE simulation method was designed. The optimization ensured a good electrical contact of the steel sheets of LITECOR® without degradation of the polymer (Figure 1 b)). The resistance spot welding (RSW) process between LITECOR® and DP600 started automatically after the displacement of the core layer was completed. Homogenous, free from defects welded joint between LITECOR® and DP600 solid material was achieved (Figure 1 c)). The quality of the welded joint was verified by statical shear tests and metallographic examinations.

In summary the ultrasonic support of the resistive process provides a low degradation of the steel sheets of the LITECOR® and a short process time of the overall forming and welding process of LITECOR® with another metallic component in a single joining process.

References

[1] M., Gude; FOREL-Studie- Chancen und Herausforderungen im ressourceneffizienten Leichtbau für die Elektromobilität, 2015

[2] M. Riemer et. al., Technologies for economic and functional lightweight design- “Novel Ultrasonic-Based Joining Methods for Metal-Plastic Composites (MPC)”, 2020, 300-312.