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Aluminum Die-Cast/Rolled Plate Friction Stir Spot Welding

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It is necessary to reduce CO_2 emissions for transportation equipment such as automobiles, and weight reduction that leads to improved fuel efficiency is an effective means. In automobiles, weight reduction of the vehicle body, which leads to improvement of vehicle performance, is effective, and the authors have been developing point joining technology, which is one of the important technologies for realizing a lightweight car body structure. Among these, in addition to joining dissimilar materials such as aluminum / steel plate and aluminum / thermoplastic fiber reinforced plastic (FRTP), we are developing joining technology between aluminum including die-cast plate materials that intended for application to car body frame members.

In this report, in order to clarify the applicability of friction stir spot welding to aluminum car body frame members, we investigated the effect of joining parameters on the joining strength of various plate assembly including die-cast materials, which are difficult to form appropriate joining nuggets by resistance spot welding due to differences in electrical resistance and melting point. In addition, the strength influencing factors were examined from the cross-sectional observation.

As a result of investigating the effect of the joining parameter on the strength, in the combination of A6111 and ADC3, it was confirmed that the larger the probe diameter, which directly affects the joint nugget diameter, the higher the strength. In addition, by using a tool with a probe diameter of 5 mm, it is possible to stably obtain shear strength that exceeds the JIS A grade average for resistance spot welding(Fig.1).

As a result of observing the cross section and examining the strength influencing factors from the joining state and crack growth path, a plastic flow was generated around the probe so that the lower plate material was rolled up toward the upper plate side. Depending on the plastic flow shape, the joining area between the interfaces, and the residual thickness of the upper plate, the crack growth path at the time of fracture changes intricately and affects the strength. In order to obtain stable strength when using the tool position control type device, it is important to properly control the actual insertion amount of the joining tool that determines the plastic flow state and the residual thickness of the upper plate(Fig.2).

In the strength evaluation based on the results of the parameter influence survey in the plate assembly assuming a general car body frame member, it was confirmed that the shear strength of all the plate assembly exceeds the JIS A grade average. In addition to evaluating the strength of various plate assembly to be used as a database for joining design and construction at the time of practical use, we will continue to make efforts such as developing strength and reliability prediction models that utilize joining CAE.

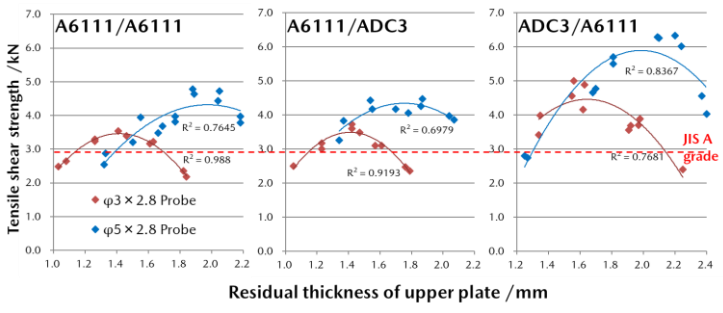

Fig.1 Comparison of weld robes by probe diameter

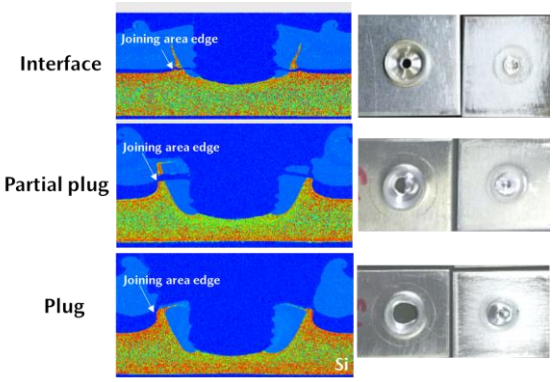

Fig.2 Comparison of fracture form