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Abstract

Title	In-situ Measurement and Formability Improvement in Stamping of High Strength Steel and Titanium Alloy Sheets

(800 words)

The information and visualization of deformation behaviour of the high strength steel sheet during the stamping process are useful for design of tools and are also strongly desirable in forming industry. However, it is not easy to measure the deformation behaviour during stamping processes since a deforming sheet is generally surrounded with complicated tools during a stamping operation, thus, application of sensors for the in-situ measurement becomes limited. The borescopes consisting of a small camera and a flexible cable have wide applicability to forming processes as an imaging sensor and the installation of the borescopes inside tools enables the in-situ measurement. The three-dimensional deformation behaviour of the sheet and tools were successfully measured using borescope.

The use of the ultra-high strength steel sheets for automobile body-in-white parts is increasing. However, the improvement of formability is strongly required. A gradually contacting punch was developed to reduce a tensile stress during the forming process with controlling a stress state around sheared edges undergoing plastic deformation. However, for stretch flanging, the punch stroke increased, thus increasing the production time and cost. In order to reduce the punch stroke, the 2-stage method using punch with recessed is used in stretch flanging.

In order to increase the safety of the cars, the structure of body member was optimization. The front rail hollow section acted as energy absorber during accident, and is permanently deformed in order to absorb the kinetic energy during the crash. This hollow sections typically joined by resistance spot welding have insufficient energy absorption because the joint are not continuous. In order to overcome this problem, the hollow section is joined using the hemming method. Since the hollow section having hemmed joins is overlapped, the strength is increased as compared to the resistance spot welding joins.

Although the titanium alloy sheet is widely used for airplane parts due to its properties of high strength at high temperatures, low density and high corrosion resistance, a ductility of the titanium alloy sheet is very low, thus difficult to be formed at room temperature. The sheets are generally formed at elevated temperatures. The hot hat-shaped bending of the Ti-6Al-4V titanium sheet using the resistance heating was carried out. The titanium alloy sheet was successfully formed at the elevated temperatures, bending load was reduced and the springback and oxidation are prevented.