



IMPROVING COLD FORMING OF ZE-GRADES BY LOCAL LASER HEAT TREATMENT

Task

Discussions on climate change and legal demands for CO₂ reductions are accelerating lightweight construction in many applications. For cold-rolled strip, for example, the trend is towards thinner and thinner sheet thicknesses and, thus, inevitably toward high-strength materials. These materials should, nevertheless, allow complex forming operations. For this, the company BILSTEIN has developed micro-alloyed ZE-grades that achieve a yield strength of up to 1200 MPa, but allow decreased degrees of deformation in further processing. Within the framework of the Federal Ministry of Education and Research's project »KLASSE«, local heat treatment with laser radiation is being investigated, a process which should improve local, cold formability of ZE-grades significantly. Laser heat treatment is used to soften the high-strength steel blanks locally in areas critical for reformation by thermally induced structural transformation (e.g. recrystallization). This way, ductility is increased, thus making high degrees of deformation possible without cracking the working material.

1 Bending tests without (left) and with local softening (right).

2 Collar-drawing experiments without (top) and with local softening (below).

Method

Strain-hardened plates were heat treated locally with laser radiation. The heat treatment was temperature-controlled with a fiber-coupled 12 kW diode laser and a rectangular beam with power density distribution similar to that of a top hat.

Result

In the heat-treated area, the work-hardened structure is recrystallized. On ZE 1100, the elongation A80 was increased by about two- to three-fold while strength decreased simultaneously. The formability was studied in collaring and bending tests. With work hardened plates, only one collar height h of 4.55 mm was achieved until the first crack appeared. With a softened area of 15 x 15 mm², the collar height increased by 36 percent and by 43 percent with a softened area of 20 x 20 mm². Thanks to the local softening, the bending angle increased from 30° to 127° in a simple bending test before the first cracks occurred.

Applications

The main area of application is the automotive industry (body, chassis), but applications in the furniture industry (bars and profiles with tight bend radii) are also of interest.

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