Laser sheet forming for straightening and relief forming of metal foils

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This paper examines the use of UV laser (ArF, 193 nm) and IR laser (Nd:YAG, 1064 nm) for metal forming operations, namely straightening and relief forming, of metal foils of 100 microns thick. To determine the influence of scale effects, sample sizes were reduced several times with a scale factor of 2, with the same laser exposure. The feasibility of straightening aluminum, copper, and brass samples for V-bending was determined. Relief forming can be performed for die diameters of 3 to 4 mm up to a depth of 1 to 2 mm. The shock-wave insulated liquid was not used during processing. To increase the proportion of absorbed irradiation and to reduce the ablative effect of the substrate, either black PVC tape was applied to the sample surface, or the area was coated with black dye. Expected stress values were obtained using known analytical equations for bending and forming, as well as theoretical stress values achievable during laser processing. Regimes corresponding to the straightening of the studied materials were determined. Validation of the numerical simulation of the process allows us to gain results for defined boundary conditions, which are consistent with the experimental ones.