Impact of Microstructure and Geometric Length Scales on Miniaturized Tensile Tests of Advanced Steels

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by

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Abstract

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In this work the mechanical properties of advanced steels are characterized by a miniaturized tensile test and compared to the results of other mechanical testing methods. Eleven steel grades were provided by *thyssenkrupp* and miniaturized specimens were cut with a dog-bone shape contour. The specimen dimensions have a constant gauge length of 4 mm, the gauge width is varying from 0.16 mm to 0.50 mm and gauge thicknesses between 1.45 mm and 0.18 mm were used. For one type of steel the dimensions were severely changed to verify an occurring size effect. The microstructure of the materials was quantitatively investigated by EBSD.

The tensile test results were correlated to Vickers hardness measurements, average grain size and *thyssenkrupp* database values for the ultimate tensile strength. Some steels reproduce the macro-scale results well in miniaturized testing whereas others show a significant drop in the performance. The overall performance of the miniaturized tensile tests were evaluated by the ultimate tensile strength and the fracture strain for one type of steel by varying the geometrical dimensions. The results indicate the importance of the standard deviation of the grain size distribution for a more independent evaluation of the size effect.

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