Connection Between Shock Wave Induced Indentations And Material Properties By Means Of Neural Networks

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Abstract. High throughput experimentation is recognized as a new scientific approach to generate knowledge and to identify new material compositions. Rapid material development involves not only fast processing of new material compositions, but also fast material characterization. These experimental methods do not aim to understand the mechanisms of new material compositions. Instead, these methods offer descriptor values, which can be connected to material properties by means of mathematical models. In this paper, a material test method is presented, which comprises a method for making hardness indentations by TEA CO2 laser-induced shock waves and an evaluation using neural networks. With the high intensity pulsed laser, a shock wave is induced on top of an indenter. The pressure of the shock wave pushes the indenter inside a test material. Indentations are created on different steel and aluminium alloys and descriptors are extracted to characterize the indentation. Following, Neural Networks are used to create the connections to the material properties. The best results are obtained when all the descriptors are included in the model, which shows that they all contain relevant information. The experiments indicate that the indentation depth correlates with the hardness, whereas the measured diameter correlates with the hardness as well as with the yield stress.