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# Experimental investigation and FE modeling of nanoindentation behavior of Ti-6Al-4V alloy for defence applications

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Instrumented indentation has become an important non-destructive procedure that can be used to evaluate the mechanical properties of a wide range of engineering materials across the nano, micro and macro length scales. The characteristic properties of biological materials and structures, organic polymers, metals, ceramics and electronic materials can also be evaluated via indentation. The simplicity of the indentation process offers a number of advantages when compared to other experimental approaches for assessing the micro-nano mechanical properties of materials and structures that possess limited volumes. Elastic modulus and hardness are the two properties that are more frequently measured by the load and depth sensing indentation technique. Furthermore, the plastic properties of a material, such as yield stress and work hardening exponent have also been extracted from instrumented indentation.

In the present investigation, nanoindentation was carried out to extract the elastic and plastic properties of Ti-6Al-4V alloy at two heat treatment conditions using Dao's inverse algorithm and the results were compared with the tensile test data. It was observed that, the elastic modulus from nanoindentation for all the test specimens was about 10% higher than the values obtained in tensile testing, which can be attributed to different size and micro structural levels that are probed. FE analysis using ABAQUS was carried out to simulate the indentation behaviour from elastic-plastic properties obtained from the inverse method. The predicted values from FEA had a good agreement with the experimental results. Pile- up and sink-in behaviour of the alloy was also studied.

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