 ICCES, vol.20, no.2, pp.45-45

Crack propagation characteristics of a high-ductility steel with layered and graded microstructures

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Summary

The structural reliability of many brittle materials such as nanomaterials relies on the occurrence of intergranular, as opposed to transgranular, fracture in order to induce toughening by crack bridging. The current work examines the role of interface strength and grain size distribution in promoting intergranular fracture in order to maintain high toughening. A layered nanostructural 304SS sheet characterized by periodic distribution of nanocrystalline layers and micron-grained layers with graded grain size evolution has exhibited exceptional properties. The in situ SEM observations illustrate that an intergranular path and the consequent interface bridging process can be partitioned into five distinct regimes, namely: propagate, kink, arrest, and bridge. The multiform, progressive, repeated crack initiation and propagation results in interlaminar multiple cracking to obtain high ductility.