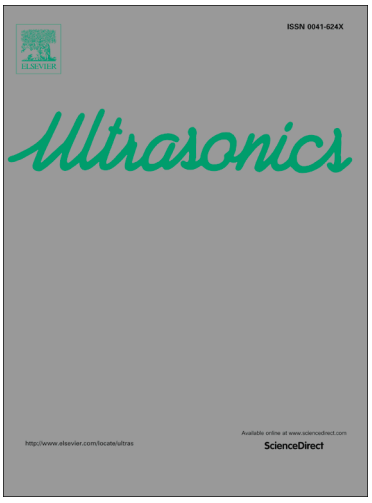

Characterization of microstructural changes due to prolonged thermal exposure of directionally solidified Ni-base super alloy CM 247LC using ultrasonic

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Characterization of microstructural changes due to prolonged thermal exposure of directionally solidified Ni-base super alloy CM 247LC using ultrasonic

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Highlights:

- Fine microstructural changes/degradation associated with γ' precipitate coarsening due to prolonged thermal exposure of a technologically important Ni-base super alloy CM 247LC has been characterized using ultrasonic techniques.
- Dislocation vibration model has been used to explain the observed variation in the second order nonlinear ultrasonic parameter as a function of precipitate size and characteristics.
- A new microstructural parameter has been identified that varies in a similar way as ultrasonic parameters.
- Findings are technologically useful for life assessment of safety critical components.

Abstract: The high temperature strength of directionally solidified Ni-base super alloy CM 247LC strongly depends on the morphology, volume fraction, size and size distribution of γ' precipitate (Ni_3Al) in the FCC γ matrix. The microstructure of the alloy is engineered to achieve the right combination of these parameters that provides the required high temperature strength and creep resistance. The alloy contains high volume fraction of coherent γ' precipitates having near cubic shape. High temperature exposure of gas turbine components made out of the alloy leads to coarsening of the γ' precipitates and broadening of the γ matrix channel. This in turn, adversely affects the high temperature mechanical properties of the alloy. The present study endeavours to non-destructively characterize such detrimental changes in the microstructure that controls the mechanical properties and limits the life of components. The microstructural changes of the fully heat treated alloy exposed at 980 °C for different hours (100-1200) of thermal exposure have been characterized using ultrasonic methods. Changes in microstructural parameters due to different hours of thermal exposure have been correlated with changes in ultrasonic velocity, ultrasonic attenuation coefficient and second order acoustic nonlinearity parameter. It is observed that the change in attenuation