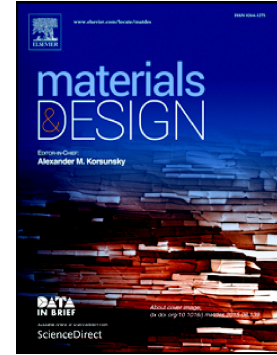


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An experimental investigation into the stress and strain development of a Ni-base single crystal superalloy during cooling from solidification

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Abstract

In-situ neutron diffraction has been used to study the stress and strain development in a single crystal Ni-base superalloy (CMSX4) during stress relaxation testing under displacement control mode. It was found that the macroscopic strain is dependent not only on stress and temperature but also on time, suggesting that the overall strain development during stress relaxation is a typical visco-plastic behaviour. The visco-plastic and lattice relaxation strain rates were obtained as best-fit equations from the experimentally measured data encompassing a range of stresses and temperatures. The relaxation lattice strain rate was found to be highly dependent on stress and temperature. It was an order of magnitude smaller than the visco-plastic strain in displacement control mode. An in-situ cooling experiment was also carried out but under strain control mode to simulate the casting condition where the metal solidifies and cools in a rigid ceramic mould. It was found that the stress relaxation was significant in this case and the lattice relaxation dominated visco-plasticity in the early stage

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