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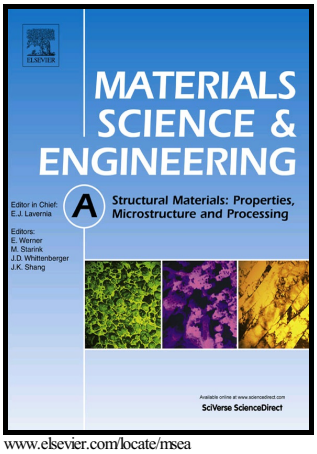


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# Dislocation structure evolution in 304L stainless steel and weld joint during cyclic plastic deformation

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**Abstract:** Dislocation structures and their evolution of 304L stainless steel and weld metal made with ER308L stainless steel welding wire subjected to uniaxial symmetric strain-controlled loading and stress-controlled ratcheting loading were observed by transmission electron microscopy (TEM). The correlation between the cyclic response and the dislocation structure has been studied. The experiment results show that the cyclic behaviour of base metal and weld metal are different. The cyclic behaviour of the base metal consists of primary hardening, slight softening and secondary hardening, while the weld metal shows a short hardening within several cycles followed by the cyclic softening behaviour. The microscopic observations indicate that in base metal, the dislocation structures evolve from low density patterns to those with higher dislocation density during both strain cycling and ratcheting deformation. However, the dislocation structures of weld metal change oppositely form initial complicated structures to simple patterns and the dislocation density gradually decrease. The dislocation evolution presented during the strain cycling and ratcheting deformation is summarized, which can qualitatively explain the cyclic behaviour and the uniaxial ratcheting behaviour of two materials. Moreover, the dislocation evolution in the two types of tests is compared, which shows that the mean stress has an effect on the rate of dislocation evolution during the cyclic loading.

Keyword: 304L stainless steel; ER308L stainless steel welding wire; Dislocation structures; Uniaxial cyclic loading; Ratcheting

## 1. Introduction

Austenite stainless steels have been widely applied in many fields, such as structural