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Cyclic softening in annealed Zircaloy-2: Role of edge dislocation dipoles and vacancies

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ABSTRACT

The mechanism of cyclic softening in annealed Zircaloy-2 at low strain amplitudes under strain controlled fatigue at room temperature is rationalized. The unusual softening due to continuous decrease in the phenomenological friction stress is found to be associated with decrease in the resistance against movement of dislocations because of the formation and easy glide of pure edge dislocation dipoles and consequent decrease in friction stress from reduction in the shear modulus. Positron annihilation spectroscopy data strongly support the increase in edge dislocation density containing jogs, from increased positron trapping and increase in annihilation lifetime.

***Keywords*:** Low cycle fatigue; cyclic stress response; dislocation dipoles; zirconium alloys; positron annihilation spectroscopy

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