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Stress assisted diffusion of krypton ions in polycrystalline titanium

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Stress migration of point and open-volume defects in materials is an important problem in a wide variety of applications, including radiation damage and ion beam modification of materials. This study aims to contribute to a better understanding of the basic processes underlying the effects of stress-assisted diffusion and ion-beam induced stress relaxation in metals. The stress profile in polycrystalline titanium has been determined using synchrotron radiation diffraction, for different krypton implantation doses. For each dose, the krypton profile has been experimentally determined using Rutherford backscattering geometry, and compared to model calculations using SRIM 2008. A strong stress relaxation was found for high dose implantation. It was further observed that for the titanium samples implanted at low fluence, ion implantation modifies the pre-existing residual stress through the introduction of point and open volume defects. The stress fields resulting from the ion implantation act to drift the krypton inclusions towards the surface of titanium.

Summary

Using synchrotron radiation diffraction, the effect of krypton implantation on the residual stress in alpha polycrystalline titanium was investigated. It was observed that a strong stress relaxation was found for high fluence implantation, whereas for low fluence implantation an additional source of tensile stress was introduced in the near surface region. It was also observed that the projected range value of the implanted krypton ions was significantly reduced than the expected range value. A possible cause of this discrepancy is the drift of implanted ions under the influence of the pre-existing stress gradient.

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