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Measurement of Phase Transformation Kinetics During Repeated Thermal Cycling of Ti-6Al-4V using Time-Resolved X-ray Diffraction Technique

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Microstructural evolution in Ti-6Al-4V alloy during laser processing s are complicated by the repeated thermal cycling above and below the $\beta \leftrightarrow \alpha+\beta$ phase boundaries. In order to track the phase transformation kinetics of $\alpha+\beta$ to β during heating and β to $\alpha+\beta$ during cooling with cycles, time-resolved X-ray diffraction investigation with synchrotron radiation was used. The measurements showed that the transformation during heating closely followed the equilibrium phase fractions as a function of temperature. However, during cooling the transformation from β to $\alpha+\beta$ lagged behind the equilibrium phase fraction when the peak temperature was higher than β transus temperature. The kinetics of β to $\alpha+\beta$ was accelerated when the peak temperature was lower than β transus temperature. The results are rationalized based on a microstructure model based on computational thermodynamics and kinetic calculations.

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