TRIGGERING NEW DEFORMATION MECHANISMS IN Ti ALLOYS BY HEAT TREATMENTS: a step forward into the improvement of the ductility and work-hardening of 3D printed parts

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ABSTRACT

The plastic behavior of Ti alloys remains a major drawback: indeed "classical" Ti-based materials usually display a low work hardening rate, bringing rapid strain localization and low ductility level. Moreover, with the lightning growth of 3D printing, the damage tolerance criterion becomes critical since fabricated alloys contain defects inherent to the process, leading to early damage upon loading. In that context, a quenching strategy has been used to promote α + α' dual-phase microstructures capable to induce martensite reorientation-induced plasticity, rather usually associated to the orthorhombic α'' martensite. The occurrence of such non classical deformation mechanism was shown to be highly efficient to improve the work-hardening and the ductility of Ti-alloys while keeping a high mechanical resistance. The present study provides a fundamental understanding of the crystallography and the microscale behavior of such martensite. The critical influence of the chemical enrichment, the texture and the morphology of the martensite on reorientation is highlighted.