

Supersolvus microstructure evolution of VDM® Alloy 780 during dynamic and post-dynamic recrystallization processes

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Increasing the efficiency of aero engines with higher operating temperatures has been the focus of developing new alloys in the last decades. VDM Metals has recently developed a polycrystalline Ni-based superalloy namely VDM® Alloy 780 aiming the application temperatures up to 750°C. Microstructure of the alloy consists of γ' hardening precipitates and δ and η precipitates to pin grain boundaries of the fcc solid solution matrix. Here we focus on the behavior of microstructure during and following the hot deformation process in single phase supersolvus domain. In this study the dynamic and post-dynamic recrystallization (DRX, PDRX) were established over a range of thermomechanical conditions. It appears that the DRX kinetics in VDM® Alloy 780 is slower than that of Alloy 718, however, the fast PDRX compensates the slow microstructural evolutions in the dynamic regime. Figure 1 shows the (a) recrystallized fraction at 1050°C at two strain rates, (b) the EBSD analyses of the microstructure just after DRX, and (c) following post-deformation holding time of 300 s at the same temperature. It was also observed that an isothermal annealing of 30 minutes at 1050°C after deformation generates homogenous and fully recrystallized microstructure even at a deformation degree as low as 8%. In addition it can be taken the advantage of the slow grain growth kinetics to finely tune the grain size by subsequent heat treatments within a time scale that is compatible with industrial conditions. Understanding the grain size evolution during complex industrial forging and heating processes will assist us optimizing the microstructure and the resultant mechanical properties at elevated temperatures.

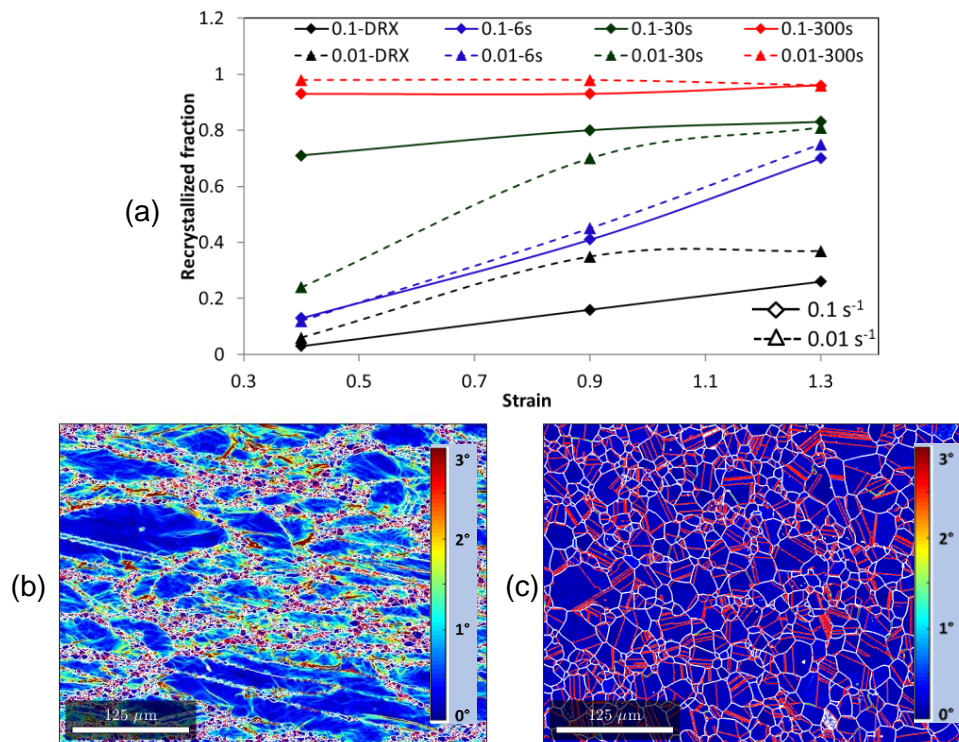


Figure 1. (a) Recrystallization fraction as a function of strain after DRX and different post-deformation holding times at 1050°C employing two strain rates. (b-c) kernel average misorientation maps using EBSD measurements indicate partial and full recrystallization at 1050°C, $\dot{\epsilon}=0.1\text{s}^{-1}$ and $\dot{\epsilon}=1.3$ before and after 300 s post-deformation holding time, respectively.