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Stored energy and recrystallized microstructures in nickel processed by accumulative roll bonding to different strains

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Abstract

The stored energy and the microstructure have been investigated in polycrystalline Ni processed by accumulative roll bonding (ARB) to different von Mises strains, ε_{vM} = 1.6–6.4. The stored energy in Ni after ARB is found to be higher than that in conventionally rolled Ni samples after similar strains, which is attributed to a finer average boundary spacing due to ARB. Annealing at 300 °C for 2 h after ARB results in recrystallized microstructures and textures, which are very different in the samples deformed to different strains. Whereas there is no dominant texture component in the ARB-processed samples annealed after strains less than 3, cube-oriented grains dominate the texture in the higher-strain samples. Nevertheless, regions near the most recently formed bonding interfaces contain a large frequency of non-cube oriented grains even in the high-strain samples. The average recrystallized grain size decreases with increasing strain before annealing, whereas the fraction of LABs formed between recrystallized grains increases. The correlation between the average recrystallized grain size, crystallographic texture and the fraction of LABs is discussed. Results obtained in this study are compared with previous findings for ARB-processed materials.

Keywords: nickel; severe plastic deformation; accumulative roll bonding; differential scanning calorimetry; microstructure; recrystallization