Controlled annealing of sandwich-structured aluminum AA1050 for optimized combinations of strength and ductility

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A heavily rolled AA1050 sample with a microstructurally continuous sandwich structure, characterized by distinct microstructural evolution in the center and subsurface layers, has been annealed at different temperatures for 2 h with the objective of establishing optimized combinations of strength and ductility. It is observed that a large reduction in the fraction of high angle boundaries taking place during recovery in the subsurface layers results in delayed onset of recrystallization compared to that in the center layer, where the change in the fraction of high angle boundaries during recovery is small. The different recrystallization rates in this sandwich structure facilitate control of the overall recrystallized fraction, and can therefore be advantageous in obtaining a desired combination of both strength and ductility. A good combination of moderate strength and intermediate ductility is obtained in the material annealed at 250 °C and 270 °C, where the area fractions of recrystallized microstructure in the center are 7% and 36%, respectively. By analyzing the dependence of mechanical strength on the microstructure it is found that the mechanical properties can be described by a simple composite model using a rule of mixtures.