Hall-Petch strengthening in Fe-34.5Mn-0.04C steel cold-rolled, partially recrystallized and fully recrystallized

An Fe-34.5Mn-0.04C steel has been processed by cold rolling and annealing to prepare samples with a lamellar structure, a recrystallized grain structure and a composite structure of layers of recovered and recrystallized structures. For the recrystallized grain structure and the lamellar structure, the flow stress has been analyzed by applying Hall-Petch formulations. For the composite structure, the rule of mixture has been applied to calculate the flow stress, revealing an extra strengthening from a constraint effect. An excellent combination of strength and ductility has been found in a composite with 10% hard lamellae in a recrystallized grain structure.