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M3Or4M-04: [Invited] Tensile properties and deformation behavior at low temperatures in ferrite and austenite duplex stainless steel with various grain sizes

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Ferrite and austenite duplex stainless steels exhibit an excellent strength-ductility balance at low temperatures. On the other hand, it is well known that grain refinement improves not only the strength but also the toughness of metal materials. In this study, the effects of grain size on the low-temperature tensile properties in ferrite and austenite duplex stainless steel having different grain sizes were revealed, and then, the improvement mechanisms of the properties by grain refinement were discussed based on the obtained deformation behavior. Three specimens of duplex stainless steel with identical chemical compositions in each phase and phase ratio but different grain sizes ranging from 2.0 to 7.4 μm were prepared. At room temperature, the strength increased, but the elongation decreased with refining the grain size. Whereas, at 77 K, both strength and elongation were increased by grain refinement. The formation of deformation-induced martensites was detected in the fractured specimens at 77 K, and its volume fraction increased with refining the grain size. Therefore, the transformation-induced plasticity effect should provide high elongation at 77 K in the fine-grained specimen. The increase in strength by grain refinement strengthening at 77 K was significantly larger than that at room temperature. These results strongly suggest that grain refinement effectively improves the low-temperature tensile properties in the ferrite and austenite duplex stainless steel.

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