

A new precipitation-hardened austenitic stainless steel investigated by electron microscopy

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Abstrak

The 56Fe16.6Cr25Ni0.9Si0.5Mn austenitic superalloy has been produced in an induction furnace; it was made from granular ferro-scrap, ferrochrome, ferrosilicon, and ferromanganese materials. Originally, this alloy had been proposed for use in high mechanical loads and high temperature conditions (such as in nuclear and fossil fuel power plant facilities). Tensile strength tests showed that the alloy has an average yield strength of about 430.56 MPa, which is higher than Incoloy A-286 (a commercially available alloy). A combination of microscopy techniques by means of an optical microscope, X-ray diffraction [XRD], scanning electron microscopy [SEM], and transmission electron microscopy [TEM] techniques were applied in order to get detailed information about the fine structure of the alloy. XRD confirmed that the alloy matrix exhibits an FCC crystal structure with a lattice parameter of about 3.60 Å and grain sizes ranging from 50 to 100 µm. The results of the TEM analysis revealed the new type of precipitations that formed at the grain boundaries. These needle-like precipitations, probably Fe/Cr-rich precipitations of the (Fe,Cr)_xCy type, acted as the source of intergranular corrosion (IGC). Small coherent plate-like and much smaller granular precipitations were found distributed homogenously along grain boundaries and inside the grains. Combining the tensile strength test and microstructure analysis suggested that these precipitations play significant roles in the hardness of the investigated sample.