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Precipitate phases in a weldment of P92 steel

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The microstructural stability of ferritic-martensitic heat resistance steels is mainly controlled by the thermal stability of precipitates that are able to retard the growth rate of subgrains. The welded zones appear to be a weak region compared to the base material (BM) and creep rupture takes place in the intercritical or the fine-grained heat affected zones (ICHAZ and FGHAZ).
In the present work, precipitates of a single-pass weld performed by the FCAW (flux-cored arc welding) process were characterized by means of a transmission electron microscope on carbon replicas extracted from the different regions generated during welding. In the as received condition, the BM of the weld, both the M23C6 carbides (M = Cr, Fe, Mo, W) and MX carbonitrides (M = V, Nb, Cr) were present. Particle size number frequency histograms, the percentage of covered area by precipitates and ternary composition diagrams were obtained for each HAZ sub-zones. The size of the precipitates and the percentage of covered area diminished from the BM to the fusion zone, where original precipitates are replaced by inclusions and (Fe,Cr)3C. A change in the distribution of solutes in M of both types of precipitates was observed between the BM and fine-grained HAZ (FGHAZ) that attained the higher temperature. A preponderance of M23C6 carbides with high W+Mo and low Cr and an enrichment of Nb at the expense of V and Nb in the MX carbonitrides were observed in the FGHAZ near the coarse-grained HAZ.

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