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Creep-induced Microstructural Evolution in a Nickel-based Superalloy designed for Advanced Ultra-Supercritical Boilers

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Abstract: Long-term microstructure stability is a major concern for candidate materials used in advanced ultra-supercritical (A-USC) power plants. In the present work, precipitation behavior of a nickel based superalloy designed for A-USC boiler, with a base composition of Ni-25Cr-20Co, was investigated during long-term thermal exposure under different stresses at 1043K. The results showed that the coarsening of γ′ precipitates in the grain interior had occurred during thermal exposure in the presence and absence of stress. The microstructure around grain boundary was altered remarkably under stress. The precipitate-free zones (PFZs) commonly existed near the grain boundary in the gauge sections of specimens after long-term creep. Coarsened and elongated particles in the PFZ were identified as γ′-Ni_3 (Ti, Al) precipitates by chemical composition analysis and diffraction pattern. Furthermore, the morphology and distribution of MC-type carbides have no significant changes observed due to their good stability, but discontinuous $M_{23}C_6$ appeared under stress, due to formation of PFZs resulting in dissolution of the adjacent $M_{23}C_6$. Besides, the creep-rupture