Oxide Nucleation in Ni-Al-Cr Alloys

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Oxidation of Ni-Al-Cr alloys that are the basis of many superalloys is dependent upon composition (i.e Al/Cr ratio) and often yields a multilayer oxide microstructure with alumina, chromia and spinel phases. The evolution of the oxide structure is controlled by competitive nucleation and growth kinetics since the thermodynamically most stable oxide is alumina. To elucidate the initial stage of the kinetic competition an oxide nucleation map has been developed based upon the relative driving free energies of the competing oxide phases for comparison to the final steady state oxide structures. In companion experimental examinations oxide nucleation has been measured with a pulse oxidation technique for comparison to the calculated oxide nucleation map.