

Precise Measurements of Lattice Parameters of γ and γ' Phases in Ni Base Alloys

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Single crystal and powder X-ray diffraction experiments of four kinds of Nickel base superalloys were carried out from 300K to 1070K at BL02B1. Fig.1 and 2 show temperature dependence of the fundamental diffraction profiles of (h 0 0) plane obtained from MC2 and CMSX-2 superalloy single crystals. Except for the diffraction profiles of CMSX-2 at 300K which seems to be a single peak, all diffraction profiles are consisted of strong and sharp peak at high angle part and very weak and wide peak at low angle part. As a result of profile analysis, high angle peak is the diffraction of precipitate, called γ' phase, which has $L1_2$ ordered structure and low angle one is that from γ phase matrix of fcc phase. These results indicate that lattice misfit, or difference of lattice parameters between γ and γ' phase of MC2 is larger than of CMSX-2 at 300K, and that γ phase peak of both alloys shifts to lower angle with temperature increase. This shift is considered to be caused by increase of lattice misfit or diffusiveness of γ phase diffraction.

The lattice parameters of γ' phase obtained from superlattice diffraction of single crystal coincided with that of isolated γ' phase powder which is electrically extracted within the fitting error (Fig.3). This result means that the lattice structure of γ' phase is not distorted hardly when coherence with γ phase exists. And one of the possible causes of the diffuse scattering of γ phase is lattice strain in γ phase due to coherence with γ' phase.

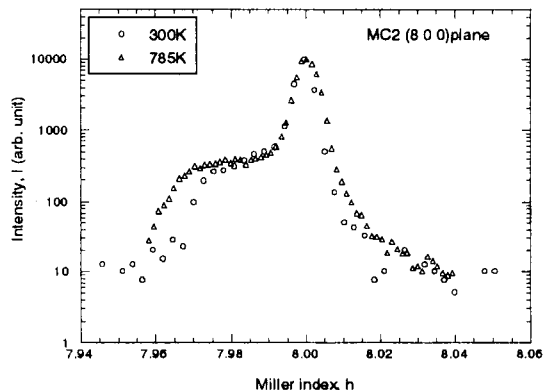


Fig.1 Diffraction profile of (8 0 0) plane of MC2 alloy

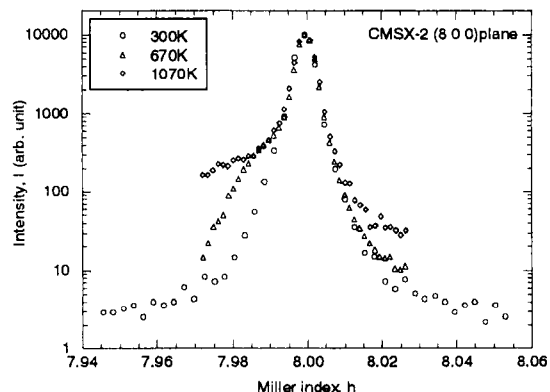


Fig.2 Diffraction profile of (8 0 0) plane of CMSX-2 alloy

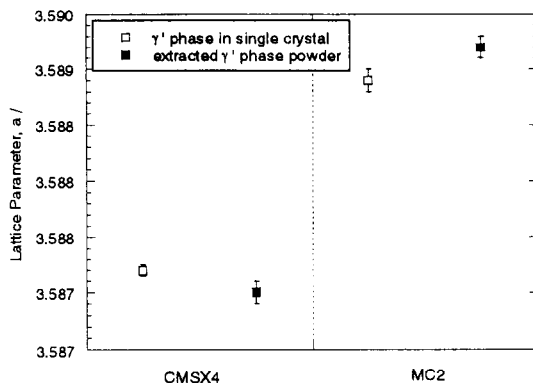


Fig.3 Comparison of γ' phase lattice parameter obtained from single crystal and electrically extracted powder