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DISLOCATIONS IN TiAl

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The L1₀ structure is a fcc related ordered phase under which TiAl crystallizes. The smallest Burgers vectors (BV) are the edges of the body centered tetragonal unit cell, i.e. [001], 1/2[110], 1/2[110] in the cubic cell (fig. 1).

Figure 1

Whereas the 1/2<110> BVs are present at any temperature of deformation, [001] is only activated at very high temperature (900-1000C). At low and intermediate temperatures, the deformation is due to dislocations with larger BVs, i.e. 1/2<112> and <011>, diagonal of the face and of the unit cell, respectively. These superdislocations dissociate in two superpartials with an antiphase boundary (APB) in between. Amongst the numerous possible dissociation schemes [1], some have been identified by weak-beam between 20 and 1000C.

. At room temperature [011] superdislocations are dissociated in a planar configuration according to (fig. 2) :

Figure 2

The screws are often found to decompose in order to give rise to 1/2<112> superdislocations :

where the 1/2[112] is dissociated in the glide plane :

This configuration, however, is unstable, the 1/2[112] can dissociate by a cross-slip mechanism involving the (111) planes according to [2] :

Since the 1/6[112] is spread over two consecutive atomic planes in order to give rise to the SESF, it is highly sessile, and it gives rise to faulted dipoles trailed by the 1/2[112] superdislocations [3].

. As the temperature of the deformation is raised up to 600C, the [011] superdislocations undergo a locking dissociation, which in turn induces an anomalous increase of the flow stress [4]. The dissociation reaction of the [011] screw superdislocations is similar to reaction (1) with the difference that the APB is now located in the (100) cube plane [5] (fig. 3) :

Figure 3

The three fold dissociated configuration is the analogous for L1₀ of the Kear-Wilsdorf model developed for L1₂. When dissociated according to reaction (5), the [011] screw superdislocations have a lower energy than at won temperature (reaction (2)). The 1/2<112> superdislocations do not thus participate to the deformation.

. At 800C, however, the Kear-Wilsdorf locks no more operate : the <011> superdislocations have completely disappeared and the 1/2<112> superdislocations are dissociated according to (4), but the 1/6[112] is glissile at that temperature.

. When deformation is conducted at higher temperature (1000C), the 1/2<112> dislocations are found to decompose according to :

$1/2[\bar{1}12] \rightarrow 1/2[\bar{1}10] + [001]$ (6)

with the $[001]$ dislocation moving in the (110) plane.

The dislocation behaviour in TiAl is thus charac-

terized by an evolution toward configurations of lowest energy, some of which are attained by a thermally-aided mechanism. These configurations are associated with small BVs, except in the domain of the flow stress peak.

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