Inamura Lab

Research on the basic principles of microstructure and discovering new approach for material design

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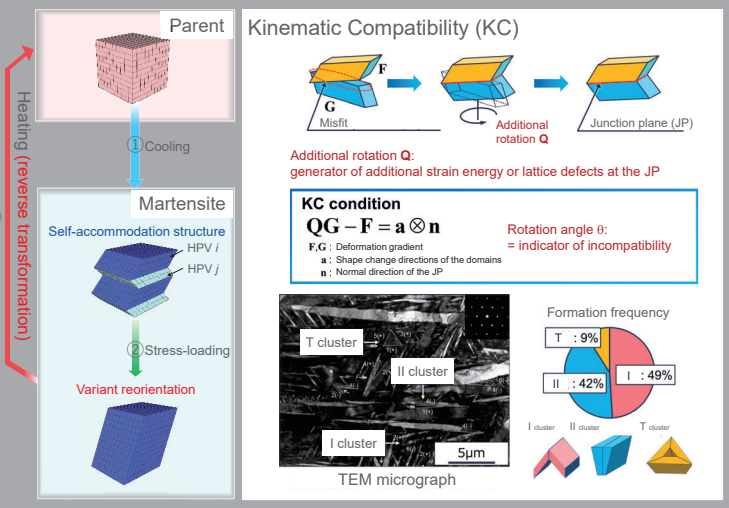
Research interest

The main focus areas of our research group are (1) microstructure of diffusionless transformation, (2) kink deformation in layered material, (3) shape memory alloys, and (4) steels.

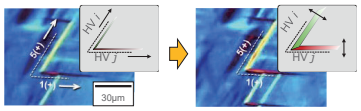
Research Topics

Long-life shape memory alloys (SMAs)

Martensite microstructure analysis based on crystallographic theory

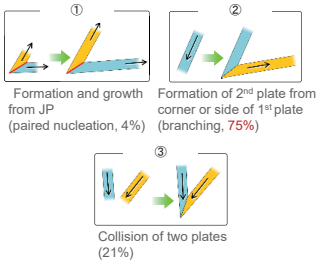


In-situ observation of HPV cluster formation process (ex: I cluster)



① Increasing in length of HPV
② Increasing in thickness of HPV

Observed type of formation process and fraction formed

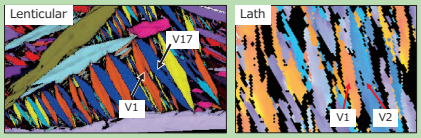


① Formation and growth from JP (paired nucleation, 4%)
② Formation of 2nd plate from corner or side of 1st plate (branching, 75%)
③ Collision of two plates (21%)

A considerable majority of I clusters form by paired nucleation or branching.

Analysis of variant-pairing tendencies (steel)

Microstructure analysis of martensite with characteristic morphologies



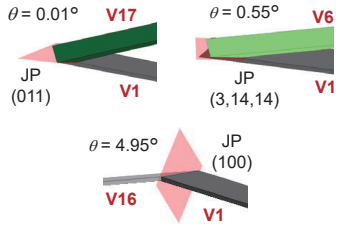
The variant pairing tendency depends on their characteristic morphologies.

Lenticular martensite in steel

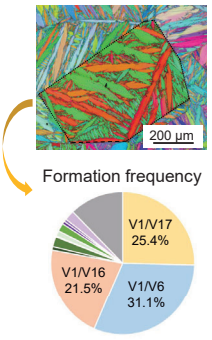
Theory

Variant pair morphologies obtained from the KC condition

Variant pairs with small θ

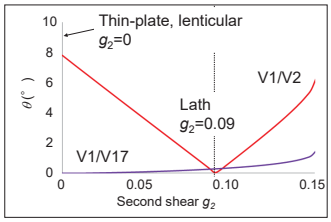


Experiment



Variant pairs with small θ are observed frequently in the actual microstructure

Effect of lattice invariant deformation on degree of incompatibility θ



Double shear theory

$$\mathbf{L}_i = \mathbf{I} + g_i(\mathbf{d}_i \otimes \mathbf{p}_i)$$

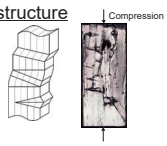
$$\mathbf{U}_{Vn} = \mathbf{R}\mathbf{B}\mathbf{L}_2\mathbf{L}_1$$

$\mathbf{L}_i$: i th shear
$\mathbf{I}$: identity matrix
$\mathbf{p}_i$: shearing plane
$\mathbf{R}$: rigid rotation
$\mathbf{U}_{Vn}$: deformation gradient of Vn variant
$\mathbf{d}_i$: shearing direction
g_i : shearing magnitude
$\mathbf{B}$: Bain deformation

Introduction of second shear
θ for V1/V2 pair (lath)↓
θ for V1/V17 pair (thin-plate and lenticular)↑

Kinematical theory of kink microstructure (Mg-Zn-Y alloys)

Kink microstructure



Contribute to the excellent mechanical properties.

→ Disclinations are formed in the kink band connections.