Orientation

강의명: 기계재료공학 (MFA9009)

정영웅

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HOMEPAGE: HTTP://YOUNGUNG.GITHUB.IO

Outline

- 강의 소개
- 평가
- 강의 진행 방식 및 규칙

출석 인정 관련 우리대학 학사 규정

- 제23조(출석인정)
  - 다음 각 호의 사유에 따라서 결석하고자 하는 학생은 **별지 서식 5 출석인정신청서에 관계 증빙서류를 첨부하여 학과장을 경유하여 총장의 허가를 얻어야 하며, 그 기간은 출석으로 인정한다**. (개정 2017.2.27.)
    1. 병사관계(신체검사 등)로 인한 결석은 그 기간 동안
    2. 본인 결혼 시에는 5일 이내 (개정 2017.2.27.)
    3. 자녀 결혼 시에는 1일 이내 (개정 2017.2.27.)
    4. 배우자 출산 시에는 5일 이내
    5. 배우자, 본인 및 배우자의 부모 사망 시에는 5일 이내 (개정 2017.2.27.)
    6. 본인 및 배우자의 조부모. 외조부모 사망 시에는 2일 이내 (개정 2017.2.27.)
    7. 본인 및 배우자의 형제자매 사망 시에는 1일 이내 (개정 2017.2.27.)
    8. 학교의 공식적인 행사참가 및 교육 등에 의한 결석은 그 기간 동안
    9. 졸업예정자(마지막 학기 등록자)의 조기취업으로 인한 결석은 그 기간 동안 (신설 2016.11.16.)

- 제24조(출석 및 성적표)
  - ③ 학생의 출석이 총 수업시간의 4분의 3에 미달된 경우의 성적은 F로 처리한다.

Internal Policy

- 지각이란
  - 교수자가 출석을 모두 부른 후 .and. 수업시간 30분 이내 도착
- 결석이란
  - 수업 시작 시간을 30분 초과하여 나타나거나, no-show
- ¼ 이상 결석시에 자동으로 F 학점 부여 (창원대학교 학칙)
- 평가
  - 출결 (10%)
    - 지각 (0.75 시간): 1회X 0.5% 차감
    - 결석 (1.5 시간): 1회X 1% 차감
  - 과제 (20%)
  - Mid-term (30%)
  - Final (40%)
- 강의자료

  https://youngung.github.io/teaching/

강의 소개

- 등급 평가 (ABCDF)
- 시간
  - 화 (52401) 10:30am – 11:45pm
  - 목 (52401) 9:00am – 10:15pm
- 15주

평가

- 등급 평가 (ABCDF)
- 평가 요소
  - 중간, 기말 고사
    - 서술형 질문 위주로
    - 강의 내용에 대한 이해가 중요
  - 출결
    - 앞서 기술한 internal policy를 따른다.

강의 진행 방식 및 규칙

- 재료과학과 공학 (Callister)가 수업 주교재. 강의 슬라이드로 수업 진행
- 그외 참고 문헌:
  - 재료 과학 / 회중당 백수현 등 공역
  - G. E. Dieter, “Mechanical Metallurgy”
  - Robert E Reed-Hill and R. Abbaschian, “Physical metallurgy Principles”
- 상시 feedback (전, 중, 후) - #52-212
- 강의 노트
  - 앞서 언급된 홈페이지에서 다운로드 (속도가 느릴 수 있으니 미리 받아두세요)
  - Find and report typos
- 과제
  - (계획) 되도록 과제없이 진행

Chapter0

Introduction

강의명: 기계재료공학 (MFA9009)

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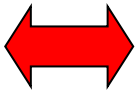
Objectives

- 금속 기계 재료 개론 수업에 전반 내용에 대한 개요를 이해한다.

Microstructural parameters, properties

Properties

- Strength
- Toughness
- Conductivity
- Corrosion Resistance
- Piezoelectric strain
- Dielectric constant
- Magnetic Permeability
- **Formability**



Microstructural Parameters

- Grain size
- Grain shape
- Phase structure
- Composite structure
- Chemical composition (alloying)
- Crystal structure
- Defect structure (e.g. porosity)

Microstructural parameters, properties

- Yes, when we study the plasticity of metals, we now should consider the microstructure of the material of interest
- Q. What is microstructure?
- A. Microstructure = internal structure

Biology was revolutionized when Leeuwenhoek and others started to use microscopes to look at the internal structure of plants. They were able to relate many characteristics of plants to their cell structure, for example.

Similarly, Sorby† was one of the first to make cross-sections of materials such as iron and examine them in the microscope, so that he could relate properties to structure.

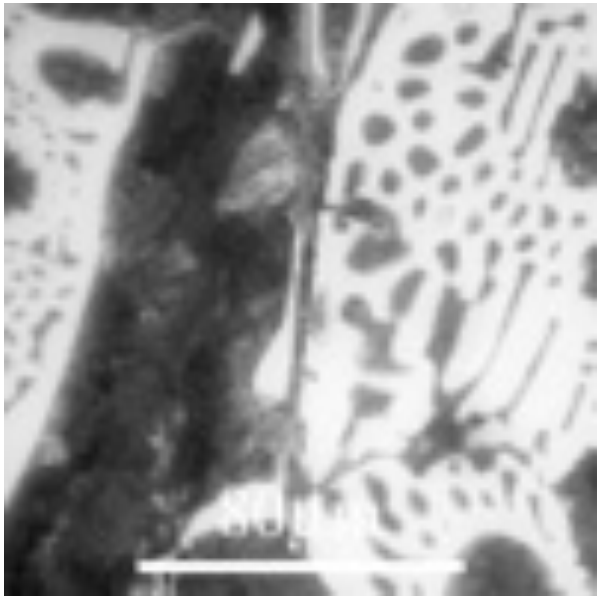
* http://www.ucmp.berkeley.edu/history/leeuwenhoek.html

† http://www.shu.ac.uk/sorby/hcsorby.shtml

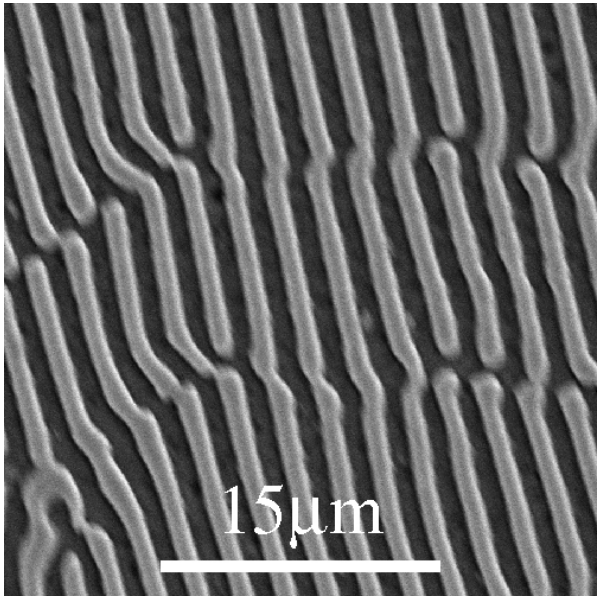
What is microstructure?

- Microstructure originally meant the structure inside a material that could be observed with the aid of a *microscope*.
- In contrast to the crystals that make up materials, which can be approximated as collections of atoms in specific packing arrangements (*crystal structure*), *microstructure* is the collection of *defects* in the material.
- What defects are we interested in? Interfaces (both grain boundaries and interphase boundaries), dislocations (and other line defects), and point defects.
- Since the invention of prefixes for units, the *micrometer* (1 μm) happens to correspond to the wavelength of light. Light, obviously is used to form images in a light/optical microscope. Thus *microstructure* has come to be accepted as those elements of structure with length scale of order 1 μm.
- Since we commonly examine materials in the microscope, we generally observe *grains* as crystallites in *polycrystals*, separated by *grain boundaries*.

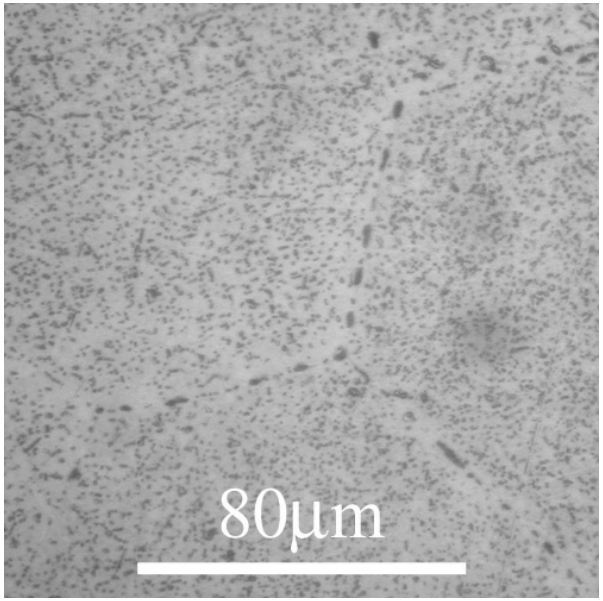
If you look ‘inside’



Fe-C-X; Hypoeutectic white cast iron

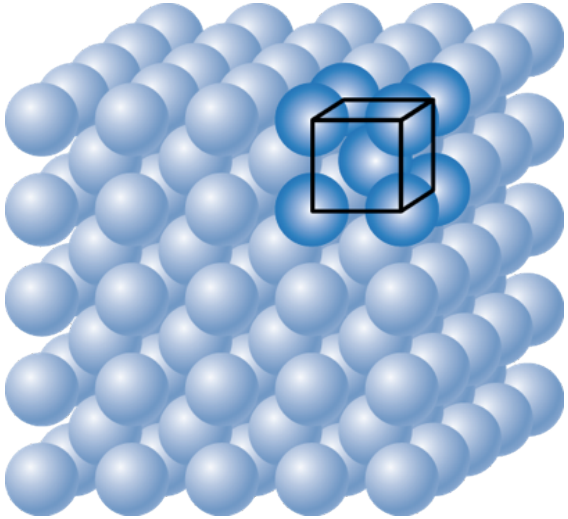


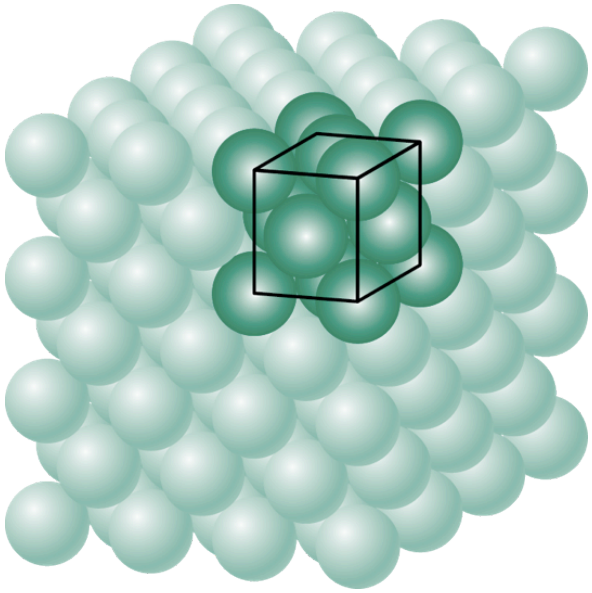
Al 67wt% Cu 33wt%, Eutectic alloy

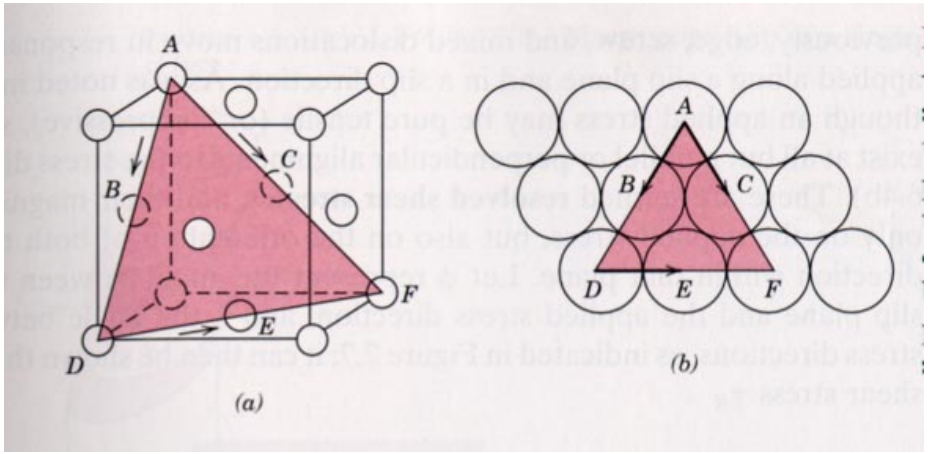


Al 96wt% Cu 4wt% Precipitates

If you look ‘inside’ (crystal structure)



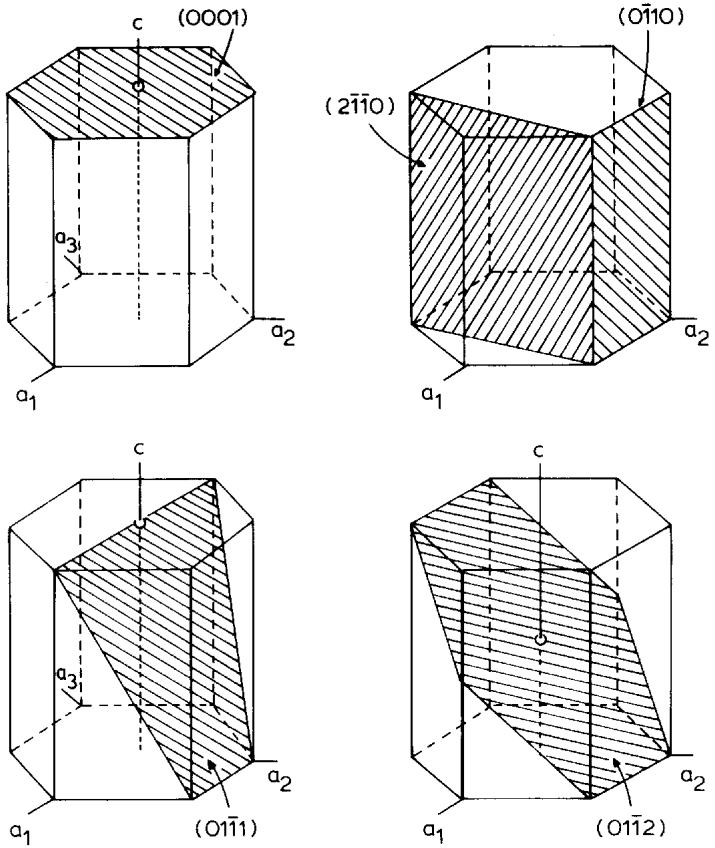




If you look ‘inside’ (crystal structure)

- HCP is more ‘anisotropic’ than cubic structures.

Basal
(0002) <2 -1 -1 0>



Prism
{0 -1 1 0}<2 -1 -1 0>
Also:
(2 -1 -1 0)

Pyramidal (c+a)
(1 0 -1 1) <1 -2 1 3>
Pyramidal (a)
(1 0 -1 1) <1 -2 1 0>

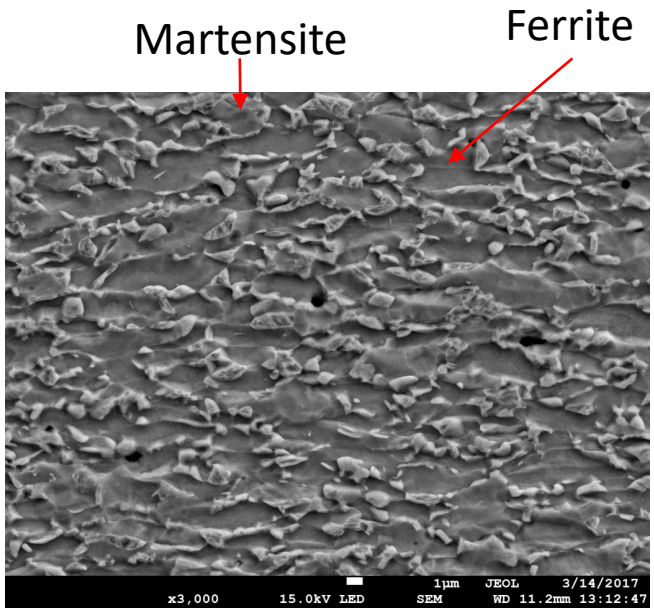
Pyramidal
(1 0 -1 2)

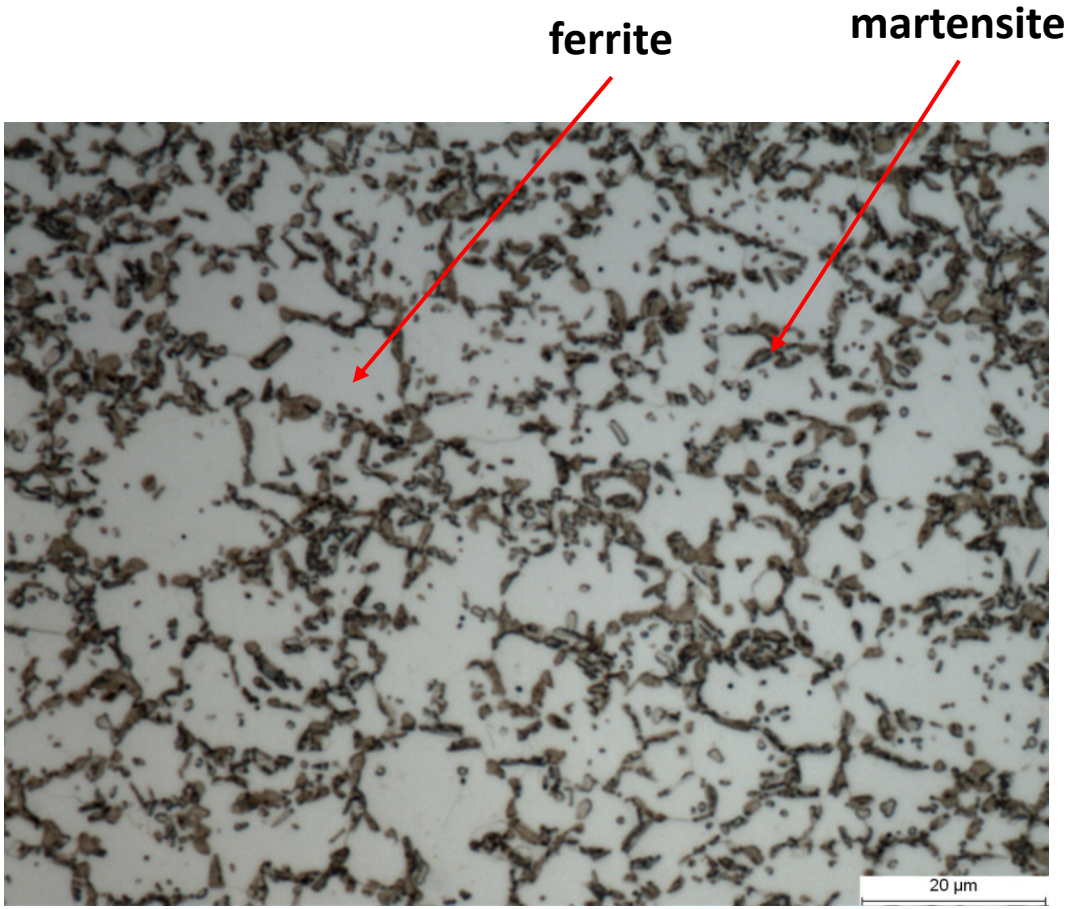
FIG. IV-5—*Some important planes in the hcp system and their Miller-Bravais indices.*

Berquist & Burke: Zr alloys

If you look ‘inside’ (multiphase)

Modern steels are often multiphase alloys





Important microstructural features

Examples of quantitative microstructural parameters:

- Grain size
- Void fraction
- Aspect ratio of second phase particles or grains
- Crystal orientation distribution (crystallographic texture)

Recap

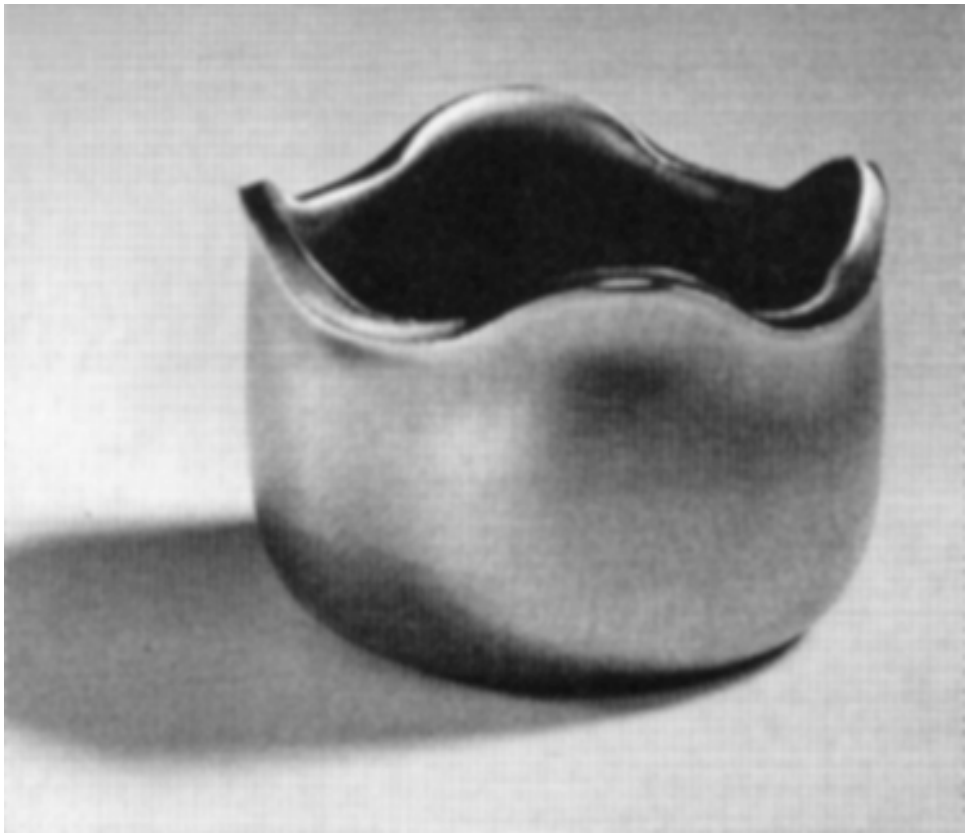
- What is microstructure?
- Multiphase steel?
- Anisotropy?
- What is grain orientation?

Anisotropy

- All crystal structure is intrinsically anisotropic.
- Q: Should polycrystalline materials consisting of many crystals anisotropic?
- Q: If not, what makes polycrystal material anisotropic?

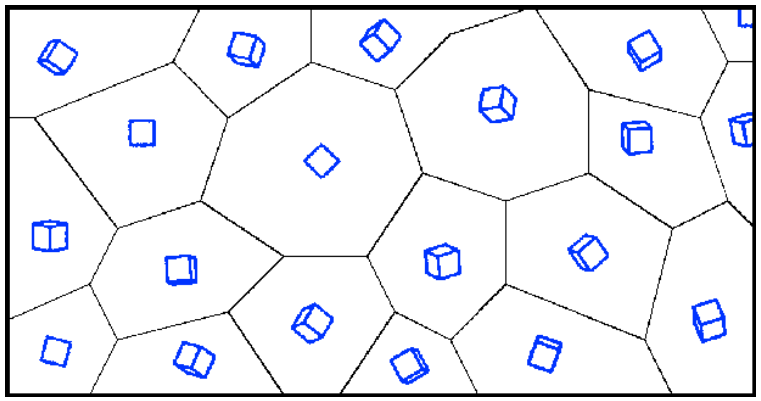
Plastic anisotropy

Figure shows example of a cup that has been deep drawn. The plastic anisotropy of the aluminum sheet resulted in non-uniform deformation and “ears.”



Randle, Engler, p.340

Grain orientation



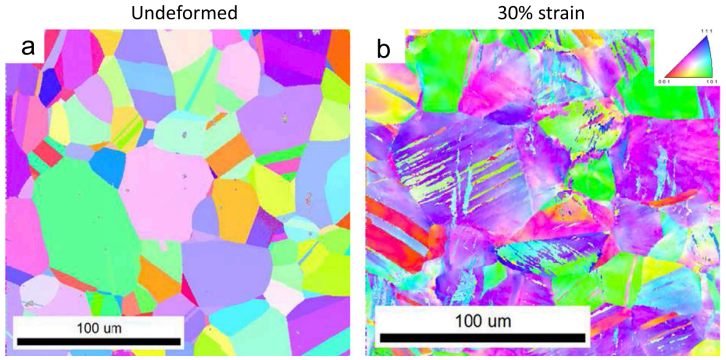
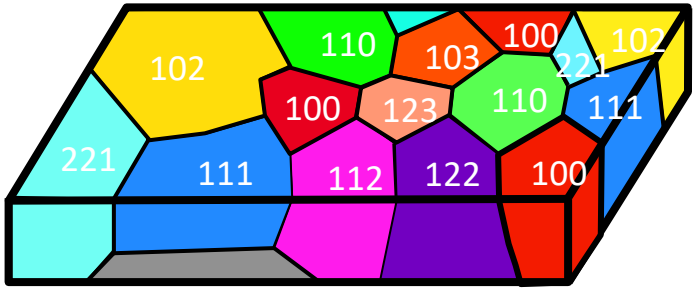


Fig. 1. EBSD orientation map of 304 stainless steel sheet at tensile strains of (a) 0% (undeformed) and (b) 30%.

Blue cubes denote unit cells representative of the pertaining grain bounded by gray lines (Q. What is the gray lines here?)



An orientation is a ‘relative term’.
상대적인 개념. 기준(reference)이 되는 방향이 갖춰져야 한다.

** H Wang, Y Jeong, B Clausen, Y Liu, RJ McCabe, F Barlat, CN Tome, MSEA 649, 2016*