Interfaces and Plastic Deformation in Materials: From Theory to Engineering (3 Credits)

材料界面及塑性变形：从理论到工程

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Synopsis	Interfaces are a main feature of crystalline materials. They play a key role in most of their properties, especially in their plastic deformation. The interface structures and defects will be described at different scales: macroscopic (geometry, crystallography, energy), microscopic (point and linear defects) and nanoscopic (atomic structure). A multiscale approach of the mechanical properties of the interfaces will be also presented, including the behaviours of interface ensembles in polycrystals.
Offering	2014 Summer Semester
Audience	Year 3 & 4 Undergraduates and Year 1 Graduate Students
Classroom	Room xxx, Teaching Bldg. No. XX, Peking University
Frequency	Class: 12-3 PM, M-F, July 7–25, 2014; Final Exam: No Exam

Objective

To develop an understanding of one of the fundamental component of the microstructure of the crystalline materials: their interfaces. The main goal of the course is to go from the concept of "ideal" interface to "real" interface in bicrystals, then to "Interface network" in polycrystals and thus, to address the opportunities emerging through "Interface Engineering".

Topics

1. Introduction: some basic knowledge of crystalline materials
2. Different types of interfaces: homophase (grain boundaries) and heterophase interfaces
3. Geometry – bicrystallography
4. Interface dislocations
5. Atomic description of interfaces
6. Energy of interfaces
7. Defects in interface structures
8. Segregation and precipitation at interfaces
9. Elementary interface deformation mechanisms: interactions between crystal dislocations and interfaces and interfacial stress relaxations
10. Interfaces and high temperature plasticity
11. Triple junctions: from free to constrained interfaces
12. Interface networks – interface texture
13. Update on the concept of interface engineering

References

1. A.P. Sutton and R.W. Balluffi, *Interfaces in Crystalline Materials*, Oxford Scientific Publications, Clarendon Press, Oxford (1995)
2. L. Priester, *Grain Boundaries and Crystalline Plasticity,* John Wiley § Sons. Inc. London (2011)
3. M. Braccini, M. Dupeux, *Mechanics of Solid Interfaces,* John Wiley § Sons. Inc. London (2012)
4. L. Priester, *Grain Boundaries – From Theory to Engineering,* Springer Series in Materials Science, Volume 172, Springer Science Dordrecht (2013).

Grading

Homework Assignment		30%
• HW 1	10%	
• HW 2	10%	
• HW 3	10%	
Midterm Project Assessment		10%
• Class Presentation	10%	
Final Project Assessment		50%
• Class Presentation	20%	
• Project Report	30%	
Attendance & Discussion		10%
Total		**100%**