

[PO-C1]Poster Session 1

Symposium C

Mon. Oct 29, 2018 5:45 PM - 8:00 PM Poster Hall

[P1-14]Possible explanation of sudden stress drop at upper yield point in iron by magnetostriction and unpinning dislocations with law of approach in residual magnetization

○Shigeo Kotake (Dept. of Mechanical Engineering, Mie Univ., Japan)

Unique mechanical properties of iron is one of important resources of engineering in modern technology. Since elastic deformation is dominant below the yield stress in iron, people can design a machine under strength of materials. Although sudden drop of stress at the upper yield point is one of prominent phenomena in iron, its mechanism has been a point of controversy in the study of mechanical properties.

On the other hand, Pitman (1990) reported sudden changes in residual magnetization of iron, which shifts towards an anhysteresis curve after applying mechanical stress. Jiles (1995) and Jiles and Li (2004) studied the magnetomechanical effect and discovered the existence of the “law of approach” in residual magnetization, in which the hysteresis converts to an anhysteresis curve under applied stress.

In this study we will try to explain the sudden drop of stress at the upper yield point from magnetostriction and unpinning dislocation with the sudden change of residual magnetization under the law of approach. Because of the positive magnetostriction coefficient of iron, specimen will show sudden drop of stress from the sudden decrease of residual magnetization, in case the initial magnetization is perpendicular to the direction of the applied force. Since the decreased magnetization has been kept, the sudden drop of stress has not been observed just after the first tensile test. Recovery of the phenomenon can be explained from remagnetization of the specimen during the heat treatment of annealing. It will be remaining study to explain the effect from temperature or strain rate to the upper yield stress.

Moreover, it has been noticed there are pinning effects between dislocation lines and magnetic domain walls. The law of approach has been explained from unpinning effect of the dislocations from the magnetic domain walls. Therefore, at the upper yield point, unpinned dislocations can move freely until contact another pinning site to enhance the decrease of stress. And we will show the possibility to understand the pinning interaction from magnetic potential between magnetic domain wall and dislocation line, where swirling electron flows.