JOURNAL DE PHYSIQUE IV
Colloque C8, supplément au Journal de Physique III, Volume 5, décembre 1995

Diffraction Profile Change in Au-Cu-Zn Alloy with Aging

T. Ohba, T. Finlayson* and K. Otsuka**

Dept. of Mat Sci. and Eng., Teikyo Univ., Toyosatodai, Utsunomiya 320, Japan
** Dept. of Physics, Monash Univ., Clayton, Victoria 3168, Australia*
*** Inst. of Mat. Sci., Univ. of Tsukuba, Tsukuba, Ibaraki 305, Japan*

Abstract : The interesting property rubber-like behavior is observed in Au-Cu-Zn alloy. The behavior appears after aging the alloy in a martensitic state though the behavior does not appear without aging. The profile measurements from several scans were made in a Au-Cu-Zn alloy and integrated intensities computed. The profile measurements perpendicular to the ($\bar{1}28$) plane were also done on the $\bar{1}30$ reflection. A diffuse maximum, which changes significantly with aging time, was observed along [$\bar{1}28$]*. These observations suggest that a local atomic rearrangement of the ($\bar{1}28$) plane occurs with aging.

1. INTRODUCTION

The aging effect on the martensite in β-phase alloys is a most interesting problem. The aging effect appears in the form of raising the As temperature and introduces the remarkable phenomenon called 'rubber-like behavior'. The characteristic point of the the rubber-like behavior [1] is that the behavior appears after aging in a martensitic state. In other words, the alloy shows plasticity in a fresh martensitic state and shows the rubber-like elasticity after aging in the martensitic state. The difference between super-elasticity and the rubber-like behavior is that the super-elasticity is related to the transformation, while the rubber-like behavior occurs without additional transformation. From macroscopic point of view, twin boundaries are related to the behavior[2], that is, the twin boundaries return to the original positions. The rubber-like behavior, therefore, is called twinning pseudoelasticity. From microscopic point of view, the origin of the driving force of twin boundary motion is not understood yet.

γ_2'Au-Cd martensite is a typical alloy which shows rubber-like behavior[1]. Au-Cu-Zn alloy also shows rubber-like behavior.[3] Recently it was also revealed that ζ_2'Au-Cd martensite shows the rubber-like behavior[4]. There are several models which try to explain the behavior[5-10]. However, no one has succeeded in explaining the phenomenon experimentally. Those models were summarized into two kinds based on their origin. One is called the boundary effect and the other is called the volume effect. In the boundary effect, boundaries themselves provide the driving force to bring back the twin boundaries to their original positions. On the other hand, in the volume effect, the driving force is in the state of the crystal itself. Recently, Murakami et al.[11] reported that even single variant martensite shows rubber-like behavior. This means that twin boundaries themselves do not provide the driving force for the rubber-like behavior.

The rubber-like behavior in Au-47.5at%Cd martensite was studied expecting the structure change with aging time. The structure factors at various aging times were measured to detect an average structure change[12]. No change in structure factors revealed that there is no change in average structure of martensite with aging. Precise measurements of X-ray diffraction profiles was also done in Au-47.5at%Cd. Small changes in profiles were observed. These small changes in diffraction profiles suggest that the local structure changes with aging.

Tadaki et al. [13] studied site occupancies of Au and Cu in Au-Cu-Zn alloy and suggested that the disordering of Au and Cu atoms may be related to the rubber-like behavior. Recent study [3] on Au-Cu-Zn martensite suggests that diffusion of defects such as vacancies in a martensite play an important role in the rubber-like behavior. From the view point of defects, stacking faults were found in Au-Cu-Zn alloy by electron microscopic studies[14,15]. Non-basal stacking faults on the ($\bar{1}28$) plane were observed as a network-like pattern with basal faults.

In this paper, the diffraction experiments were done to observe diffraction profiles with aging time and to find the correlation between the defects and aging time in the martensitic state. Specifically, the diffraction