Magnesium alloys containing rare earth elements are known to show good heat resistance.\[1\] The Mg-Gd alloy shows good age-hardenability, and the Mg-Gd-Y alloys have been developed for practical Mg alloys by Kamado et. al. to reduce the density of alloy and these alloys have a good creep resistance, even 523 - 573 K.\[1\] In our previous study, Mg-Gd-Y alloys show the mono-layer structure has been discovered before $\beta''$ phase with DO$_{19}$ structure in the aged sample at 473 K, and the $\beta''$ and $\beta'$ phases with bco structure co-existed at the peak aged condition.\[2\] Recently, Nishijima et al. detailed examinations on the precipitation behaviours of Mg-Gd alloy and Mg-Y alloy by high angle annular dark field - scanning transmission electron microscopy (HAADF-STEM) technique.\[3\] They concluded that the arrangement of bright dots indicates the short range ordered state and the $\beta'$ phase nuclide in the short range ordered structure. And they have a doubt for the existence of the $\beta''$ phase with DO$_{19}$ structure. Moreover, they presented a new structure model for the $\beta'$ phase, an Mg$_{7}$RE-type structure different from the previously proposed Mg$_{15}$RE-type. In this study, the early stage of aging in Mg-2.9at.%Gd-0.8at.%Y alloy has been observed by high resolution transmission electron microscopy (HRTEM), HAADF-STEM and calculations of images and electron density and bond overlap population (BOP) by first principal to understand the origin of precipitation in this alloy. Fig.1 shows HRTEM image in as-quenched specimen. In HRTEM image, some lines which has brighter (or darker) dots having spacing of 0.64 nm on the mono-layer of \{1-100\}$_{Mg}$ plane in the as-quenched sample. Fig.2 shows HRTEM image obtained for the alloy aged at 473K for 7.2ks. The $\beta'$ phase has four atomic layers periodicity in the [1-100]$_{Mg}$, and the arrangement of the bright dots with space of 0.64nm is observed. At the under-aged condition, precipitates observed by HRTEM were classified as follows; mono-layer, a part of $\beta''$, $\beta'$. By HAADF-STEM observation, zig-zag structure, small hexagonal network, and $\beta'$ can be recognized. The small hexagon of 0.37 nm is the first precipitate in this alloy, and this is the evidence of short range ordering close to DO$_{19}$ structure. This is referred as the pre $\beta''$-phase. Finally, we concluded that the proposed precipitation sequence is as follows; S.S.S.S. $\rightarrow$ pre $\beta''$ phase having DO$_{19}$ SRO $\rightarrow$ $\beta''$ $\rightarrow$ $\beta'$. 

Fig. 1: HRTEM image obtained for as-quenched sample.

Fig. 2: HRTEM image obtained for aged sample at 473K for 7.2ks.