Some New Insights into the Beta to Omega Solid State Phase Transformation in Titanium Alloys

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The omega phase is commonly observed in many commercial beta or near-beta titanium alloys on quenching from above the solutionizing temperature in the single beta phase field. These omega precipitates typically have an embrittling effect on the alloy and are therefore considered detrimental for its mechanical properties. However, since omega precipitates are highly refined (nanometer scale) and homogeneously distributed, they can potentially act as heterogeneous nucleation sites for the precipitation of the equilibrium alpha phase. This leads to a homogeneous distribution of refined alpha precipitates that can substantially strengthen the alloy. Therefore, the detailed investigation of omega precipitation in the beta matrix of titanium alloys is rather important. The present study, primarily focuses on omega precipitation within the beta matrix of simple model titanium alloys, such as the binary Ti-Mo, as well as the ternary Ti-Mo-Al system. Quenching from beta solutionizing temperatures results in the formation of athermal omega precipitates that are typically considered to inherit the composition of the parent beta matrix. These athermal omega precipitates are formed by a displacive mechanism that transforms the structure from *bcc* to hexagonal via a collapse of the {111} planes of the parent *bcc* phase. On subsequent isothermal annealing, coarsening of the omega precipitates is accompanied by the diffusional partitioning of the alloying elements. Advanced characterization techniques such as 3D atom probe (3DAP) tomography and high-resolution scanning transmission electron microscopy (HRSTEM) will be employed for determining the true atomic scale structure and chemistry changes associated with the precipitation of omega as a function of heat-treatments in these alloys.