# ELECTRON MICROSCOPY OF NICKEL BASES ALLOYS.

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Nickel based alloys are extensively used in the energy industry and in the aeronautical industry. The nickel is the ideal base for these alloys because it possesses a high melting point and an appropriate oxidation and corrosion resistance, dissolving metallic elements that are good to harden them and to improve its properties. The mechanical properties of this type of alloys, for example the INCONEL 100, INCONEL 713 AND THE CMSX-2 depend strongly on the precipitation of the gamma prime. This phase is a intermetallic compound of the type $Ni_3(Al, Ti)$ of ordened structure. The gamma prime precipitates are in a f.c.c. phase that it is fundamentally a solid solution of nickel. The properties of the alloy are associated to the morphology and fraction in volume of these phases. When these alloys are used at high temperature and under a field of tensions they are subjected to creep fenomena, where it plays an important part the grain boundaries, in very special cases it can be a monocristal to avoid this effect, but equally it is translated in the morphology of the phase precipitate. Considered the sizes of the phase precipitate and the characteristics of the border of the grain the electron microscopy is the appropriate technique for the study of the characteristics of these alloy. The SEM allows to observe the morphology of the phase precipitate clearly and is posible to determine its volumen fraction, Figure 1, but it is not possible to know the characteristics of the strain field arounds the particle. An image of TEM of these second phase particles can be observed in the Figure 2. The Figure 3, shows interface dislocations between the precipitate and the matrix. This allows to determine the misfit between the particles and the matrix, for these coherent particles the misfit is very low and this dislocations structure allows to determine it misfit. This information is very important because this is associated to the speed of growth of the particles. The contrast of this particles for structure factor, that is to say for the difference of the extinction distances between the precipitate and the matrix. This allows to observe the big particles, but not the very small ones that are not observed in bright-field. This is the case of the secondary gamma prime phase that cannot observed in briht-field, only showing in dark-field, when a diffraction spot from the superestructure of the primary gamma prime phase is used. Figure 4 shows secondary gamma prime phase between primary gamma prime phase, that can only be observed in dark field. Another characteristic of these phases precipitate is its growth in a preferential directions, even in absence of a strain field like is observed in the Figure 5, also we can see the modification of the contrast due to the interaction between the particles. In the Figure 6 you can appreciate like it changes the distribution of dislocations when this growth takes place. All these examples show the importance of the electron microscopy for the study of this type of alloys and fundamentally in the determination of the misfit, critical point to be able to control the kinetics of growth of the particles. Many elements are used with the purpose of modifying the precipitate lattice parameter and then the misfit between precipitae and matrix. Another central point is they range of work temperature, if in this range the presence of secondary gamma prime phase, is possible as metaestable phase, its effect on the content of elements of the matrix in the close to of the primary gamma prime phases, should be considered.