This thesis deals with the system of titanium and hydrogen. Interstitial hydrogen alloys and hydrides are subject to intensive investigation, both theoretical and experimental. It has been proved, that absorbed hydrogen lowers the formation energy of defects in metals, and thus works as the so called 'defactant'. Surfactants on the surfaces of liquids lower the surface tension; defactants in solids lower the formation energy of defects. It has also been proved, that titanium absorbs hydrogen readily, when exposed to high temperature, or high pressure (fugacity); while different loading conditions lead to different features of the final sample. Beside ordinary coarse grained titanium, ultra-fine grained titanium shall be studied in present work, due to its high content of defects. Positron Annihilation Life-time Spectroscopy, a non-destructive technique sensitive on open-volume defects, shall be of prime importance in our investigation. We shall further use the X-ray diffraction, Micro-hardness measurements and Differential Scanning Calorimetry together with Thermogravimetry. Lastly, we shall strongly benefit from using existing computational tools like the Vienna ab-initio Simulation Package, or Pos330; a program for positron life--times calculations.