# TEM Characterization of a TiN/Ti(+N)/Ti Mixture Layer Formed by Nitrogen Ion Implantation into Titanium

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**Abstract.** Commercially pure titanium was implanted by nitrogen in order to form titanium nitrides, which significantly improve titanium surface properties. Implanted material was characterized by XRD, which indentified hexagonal structure of the $\alpha$-Ti matrix, a mixed Ti(+N) solid solution and cubic $\delta$-TiN surface nitride. Small bubbles on the surface of implanted sample were observed using dual beam SEM. A TEM lamella was created from the implanted sample by a FIB in-situ lift-out technique. Microstructure characterization of FIB lamella was performed by transmission electron microscope (TEM) equipped with GATAN post-column filter (GIF). TEM analysis shows that material has a TiN/Ti(+N)/Ti mixed layer structure. Individual layers were identified and characterized by SAED, EDS, EELS and EFTEM techniques. STEM EELS technique was used to identify the nitrogen implantation depth into the pure Ti. Plasmon peak changes when N atoms are present inside Ti matrix in this mixed Ti(+N) solid solution layer. The N-*K* edge, as well as energy shift of Ti-$L_{23}$ edges is associated only with the TiN layer.