Chemical analysis of buried interfaces and interlayers.

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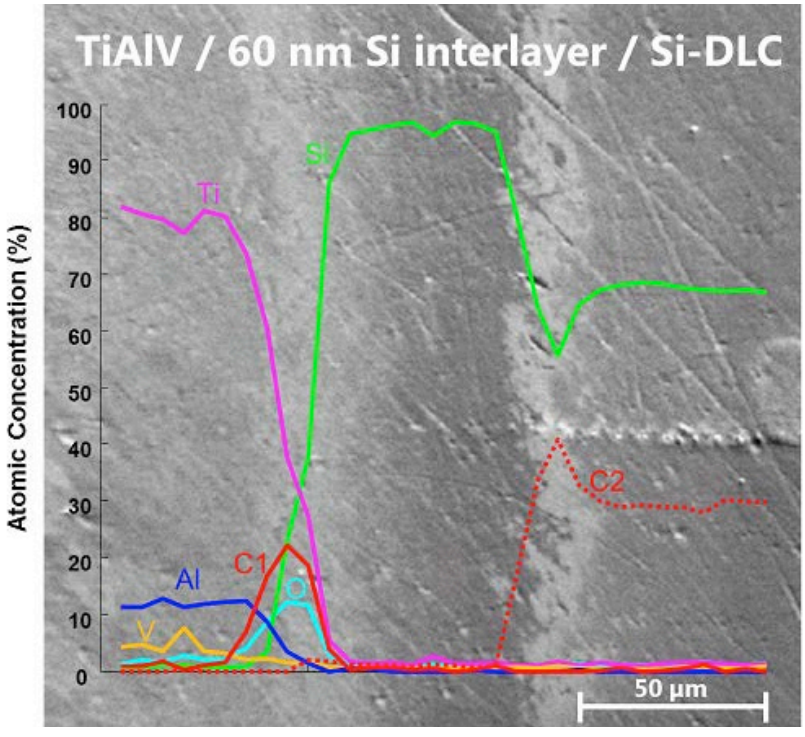
Abstract

When coating a substrate material via PACVD, good adhesion is achieved when the coating atoms form a strong chemical bond with the substrate material at the interface. Depending on cross contamination during sputter cleaning and also the oxygen partial pressure during deposition, additional elements will be incorporated into the few atomic rows of the reactively formed interface material. Chemical analysis of an interlayer or an interface is demanding since a depth resolution in the nanometer range is required at the interfaces which are buried under several micrometers of coating.

We will demonstrate through adequate extremely low angle cross-section polishing with an argon beam, it is possible to polish the interfaces at an angle of less than 0.06 degrees with respect to the interface plane (less than 1/1000 steepness). This preparation expands a few nm thick interface to several micrometer laterally, allowing us to quantitatively measure the chemical composition, including the amount of contamination at an interface, by scanning Auger microscopy analysis. The figure displays a SEM picture of the low angle polished interfaces and Si interlayer of a failed 4 µm DLC coated hip joint explant [1]. The Auger analysis shows the 60 nm Si interlayer and a contamination at the TiAlV/Si interface. C1 and C2 indicate two different chemical states of C. It will be shown that small amounts of contaminants at an interface correlate with an increased sensitivity toward delamination when dynamical load is applied on the interface in a corrosive media. Furthermore, the lateral expansion of the interface or interlayer by more than a factor of 1000 open the possibility of determining the corrosion and crevice corrosion sensitivity of these particular areas by electrochemical microcapillary technique.



[1] R. Hauert, C.V. Falub, G. Thorwarth, K. Thorwarth, C. Affolter, M. Stiefel, L.E. Podleska, G. Taeger, Acta Biomater. 8 (2012) 3170.