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Surface hardening after film deposition - combining TiAlN tribiological coatings with subsequent electron beam treatmentKai Weigel¹, Martin Keunecke¹, Klaus Bewilogua¹, Rolf Zenker², Sebastian Schmied², Gundis Grumbt²¹Fraunhofer IST, Braunschweig, Germany ²Technische Universität Freiberg, Freiberg, Germany

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By applying electron beam treatment on various TiAlN hard coated steel substrates a substantial gain in adhesion was observed. Structural and elemental analysis show that all three components are subject to changes: the substrate, the coating and the interface. Hard coatings cannot exploit the full range of their excellent properties if the used substrate materials are too soft. Therefore it can be beneficial to carry out an additional heat treatment before or after the coating process. Especially if the coating deposition requires high temperatures a case hardening after coating deposition is an effective new approach. The investigations presented here were focused on a combination of the deposition of TiAlN coatings and a subsequent electron beam surface hardening. The TiAlN coatings with variable compositions and mechanical properties were deposited by reactive magnetron sputter deposition onto two different tool steels. The TiAl targets and the substrate were excited both by DC and pulsed DC voltage. For electron beam hardening a rectangular energy transfer field was used. The energy distribution within the field caused a nearly constant hardening temperature on the material surface during the whole hardening process. Besides composition and structure of the coatings before and after electron beam treatment their hardness and adhesion were studied. Depending on the coating's composition and thickness morphological changes of the coatings could be observed. Coatings of 1 μm thickness showed severe cracks while these were not observed on coatings of 3 μm thickness and more. Especially for coatings with insufficient adhesion on untreated steel the electron beam hardening caused a significant improvement. The considered combination of coating deposition and subsequent EBH seems to have a high potential for locally highly loaded tools or components.

KeywordsTiAlN hard coating
electron beam
case hardening
adhesion