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Application of the electron beam evaporation for high-rate coating of 3D-parts

Jens-Peter Heinß, Heidrun Klostermann

Fraunhofer FEP, Dresden, Germany

jens-peter.heinss@fep.fraunhofer.de

PVD and CVD are versatile techniques to deposit high quality coatings on tools and parts. They provide coatings of a wide variety of compositions and structures, including nitrides, carbides, oxides and also complex compounds. For the coating of parts, i.e. non-flat substrates, the arc evaporation and the magnetron sputtering techniques are established in typical batch coating devices, where substrates rotate during coating processes of typically several hours duration. Electron beam evaporation opens up the possibility of highly productive coating processes also for 3D-shaped substrates.
NOVELLA, a novel laboratory equipment for the coating of three-dimensional parts is a platform that integrates the electron beam evaporation technology. High rate evaporation using an axial beam gun, assisted by a powerful hollow cathode plasma source enables deposition of high quality coatings. Including a load lock and a versatile substrate transport system, it allows establishing direct process sequences of different deposition techniques including magnetron sputtering and PECVD.
By the example of titanium nitride, we describe in detail the used technology. The coating experiments were carried out with deposition rates up to 180 µm/h. This rate number illustrates the productivity potential of the electron beam evaporation and represents the precondition for a cost effective coating technology. The properties of the layers are completely comparable to sputtered coatings. We measured hardness of 30 GPa and Young's modulus of 380 GPa for the evaporated TiN layers deposited with moderate bias voltages. Further characterizations of the layer structure will be given in the talk.
Additionally, we will give an overview about other coatings which were deposited by high-rate electron beam evaporation in the near past in order to illustrate the possibilities of this coating technique in view of different surface functional requirements on 3D-parts.

Keywords
plasma-activated evaporation
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coating 3D-parts