DS 34: Hard and Superhard Coatings

Time: Thursday 15:45–16:45 Location: H 2032

DS 34.1 Thu 15:45 H 2032

Doping of high quality c-BN films epitaxially grown on top of diamond(001) — •Hong Yin[1], Xuyang Wang[1], Ivan Pongrac[1], Paul Ziemann[1], Fabian Renaux[2], Michel Hecq[2], and Carla Bittencourt[2] — [1]Institut für Festkörperphysik, Universität Ulm, 89069, Ulm, Germany — [2]University of Mons-Hainaut, B-7000 Mons, Belgium

Since it first synthesis in 1957 cubic Boron Nitride (c-BN) has attracted considerable interest due to its extreme physical and chemical properties. Besides as a superhard material second to diamond, it exhibits a wide band gap (6.4 eV) and high thermal conductivity making c-BN attractive as a high temperature electronic material. The recently achieved heteroepitaxial growth of c-BN films on top of diamond(001) [1] opened a promising window for e.g. c-BN/diamond pn-junctions. We will present results on the doping of high quality c-BN samples epitaxially grown onto diamond(001). XPS combined with ToF-SIMS results showed that metallic impurities within such epitaxial films are below several ppm leaving carbon and oxygen as the main impurities, which are homogeneously distributed inside the film. As a result, the nominally undoped c-BN films are p-type conducting as revealed by Hall effect. Si^+ was chosen to dope these epitaxial c-BN films by either in-situ adding Si^+ during film growth, or ex-situ doping by cold implantation and rapid thermal annealing (CIRA). In both cases, the electrical resistance of the samples is significantly decreased. Hall effect measurements indicate a related n-type conduction.

[1] X. W. Zhang et al., Nature Mater. **2** (2003) 312.

DS 34.2 Thu 16:00 H 2032

Abscheidung und Anwendungen von Kohlenstoffnitridschichten (CN_X) für Bauteile und Werkzeuge — •Ulrike Springborn[1], Katharina Köster[1], Mohammad Djahanbakhsh[2], Rolf Wäsche[2], Martin Keunecke[1] und Klaus Bewilogua[1] — [1]Fraunhofer Institut für Schicht- und Oberflächentechnik, Bienroder Weg 54 E, 38108 Braunschweig — [2]BAM Bundesanstalt für Materialforschung und -prüfung, 12200 Berlin

Bei den Versuchen zur Herstellung der superharten Phase des Kohlenstoffnitrids wurden interessante mechanische und tribologische Eigenschaften des Materials CN_X mit X zwischen 0 und $0,2$ gefunden. Dazu gehören eine sehr geringe Oberflächenrauhigkeit, geringe Kontaktwinkel, hohe Elastizität und eine einstellbare Leitfähigkeit. Dünne CN_X-Schichten mit Schichtdicken von 10 nm und weniger werden in der Festplattenherstellung als Schutzschichten verwendet. Die Charakterisierung der tribologischen und mechanischen Eigenschaften dickerer CN_X-Schichten, zum Beispiel Härte, Verschleiß und Kontaktwinkel, soll eine mögliche Anwendung der CN_X-Schichten in der Bauteil- und Werkzeugbeschichtung untersuchen. Die CN_X-Schichten mit Schichtdicken bis zu mehreren Mikrometern werden hierfür mit dem in der Industrie weit verbreitetem Magnetronsputterverfahren unter variierenden Parametern hergestellt. Diese Parameter sind der Target-Substrat-Abstand, die Substrattemperatur und der Stickstofffluß. Ergebnisse aus den Untersuchungen zu Schichtzusammensetzung, Härte, Verschleiß, Reibungs- und Benetzungsverhalten werden dargestellt und diskutiert.

DS 34.3 Thu 16:15 H 2032

Scanning probe microscopy based characterization of reactive sputter deposited coatings — •Thomas Klünsner[1], Gregor Hlawacek[1], Christian Teichert[1], Nazanin Fateh[2], Harald Köstenbauer[2], Gerardo Fontalvo[2], and Christian Mitterer[2] — [1]Institute of Physics, University of Leoben, Austria — [2]Dept. of Physical Metallurgy and Materials Testing, University of Leoben, Austria

Scanning probe microscopy, in particular atomic-force microscopy (AFM) with its derivatives, is suited for quantitative morphological characterization of thin solid films and the evaluation of their physical properties on the nanometer scale. Here, we applied atomic force microscopy in tapping mode to study the surface morphology of reactive magnetron sputtered V_2O_5 films on MgO(001) and TiN/Ag nanocomposite films as a function of substrate temperature or Ag content, respectively. Correlation function analysis was used to determine the rms roughness, the vertical correlation length, and the Hurst parameter. In addition, the AFM images revealed the three-dimensional shape of the plate-like crystallites formed in the polycrystalline phase above 80 °C. The results allow in conjunction with electron microscopy, x-ray diffraction and Raman spectroscopy to establish synthesis-structure relations of the film Finally, preliminary friction force microscopy measurements performed in contact mode will be presented to demonstrate the possibility to determine the friction coefficients of the coatings as a function of deposition conditions.

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DS 34.4 Thu 16:30 H 2032

AlCrVN - Design of high-temperature low-friction hard coatings — •Robert Franz[1], Jörg Neidhardt[1], Markus Lechthaler[2], Peter Polcik[3], and Christian Mitterer[1] — [1]Christian Doppler Laboratory for Advanced Hard Coatings at the Department of Physical Metallurgy and Materials Testing, University of Leoben, Austria — [2]Oerlikon Balzers Coating AG, Balzers, Principality of Liechtenstein — [3]Plansee Lechbruck GmbH, Lechbruck, Germany

As environmental and economical considerations favour cutting with reduced coolants, controlling the friction becomes a major issue for the development of wear protective tool coatings. Common state-of-the-art coatings like AlCrN exhibit a relatively high friction especially at elevated temperatures, which leads to even higher thermal loads at the cutting edge and consequently to failure by thermal degradation. The incorporation of V into AlCrN results in a distinct reduction of the coefficient of friction at 700°C as the lubricious oxide V_2O_5 is formed. The new $Al_xCr_yV_zN$ coatings were synthesised by means of physical vapour deposition using an industrial-scale arc-evaporation system. The desired metastable face-centered cubic (fcc) structure was stabilised even at an Al concentration of x=0.7 by using higher energetic growth conditions. Due to this structural evolution hardness and residual stress values comparable to fcc-AlCrN were retained. Annealing experiments in ambient air at temperatures ranging from 550-700°C revealed the formation of a V-rich oxide scale due to the immiscibility of V_2O_5 with the other oxides formed (Al_2O_3 and Cr_2O_3).