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Transparent AlN-based nitride films

Erik Lewin

Uppsala university, Uppsala, Sweden

erik.lewin@kemi.uu.se

The lecture will give an overview of recent research on AlN-based thin film materials. Focus of the lecture will be on coating structure / microstructure, the material properties, and their correlations. AlN is a well-known wide band gap semiconductor which is transparent into the UV-range. By alloying AlN new materials with modified optical, mechanical and electrical properties can be attained. The alloying can lead to three types of coating structures: solid solution phases where the alloying element substitutes Al or N in the wurzite type AlN structure; nanocomposites where the alloying leads to the formation of a second phase and a two-phase microstructure; or totally amorphous or glass-like materials. What is formed will depend on the alloying elements, their concentrations, and the growth conditions.
Specifically, structure and properties of AlN-based coatings alloyed in two directions will be presented: alloying with group 14 elements (Si, Ge, or Sn), and with oxygen. By this double alloying, producing quaternary oxynitride materials, a wide range of mechanical and optical properties becomes attainable, e.g. achieving hardnesses up to 32 GPa, and a continuously variable optical band gap between 2.5 and 6.9 eV. Such properties could e.g. be utilised in protective optical coatings with tuneable absorption or decorative coating.
Coatings were deposited by reactive magnetron sputtering, using elemental targets and varied ratios of the three process gases Ar, N_2 and O_2. Deposition was generally carried out at low temperatures to allow formation of metastable solid solution phases. Coatings have been characterised using mainly X-ray diffraction (XRD), photoelectron spectroscopy (XPS) and scanning electron microscopy. Optical and mechanical properties have been evaluated using nanoindentation and UV-vis spectroscopy.

Keywords
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