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Development of a (CrAl)N Coating for Precision Glass Lens Moulding and Comparision to an Industrially used Coating

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The demand for smaller and more precise technical products needs new competitive and innovative production methods for a multitude of technologies. Great efforts are made on precision and complexity of optical systems. The new technology precision glass moulding has potential to displace used production methods in bulk production. To ensure the high quality requirements concerning surface roughness and shape tolerance of the moulding tool, high demands are made on the material and process technology. To prevent sticking or reactions between hot glass and moulding, and to reduce abrasive wear of the die a protective coating is deposited on the tool.
In this research a PVD (Physical Vapour Deposition) coating based on the system (CrAl)N is developed for the application precision glass moulding. The ternary system Chronium-Aluminium-Nitride shows excellent corrosion behaviour against many materials. The coating is produced with the laboratory MSIP (Magnetron Sputter Ion Plating) PVD System Leybold Z400. For development of the coatings different analysis methods like scanning electron microscope, measurement of hardness and Young's modulus are used. Hardness varies depending on process parameter and nitrogen content between 12 GPa and 20 GPa universal hardness. For qualification a comparison with an industrially used coating based on the elements platinum and iridium is conducted. The properties of the coating system in contact with hot glass are analysed using a thermal cycle test. For this purpose the specimen covered with glass is heated up to process temperature. To avoid unrequested reactions between atmosphere and glass or coating a N_2-atmosphere as used during moulding process is applied. The used glass is a Low-T_g-Glass specially developed for precision glass moulding. Because of the low transition temperature (<600°C) a low moulding temperature can be applied. Thermal cycle tests are analysed by phase analysis using XRD (X-Ray Diffraction) and SEM cross sectional pictures before and after testing. Chemical composition is analysed using EDS (Energy dispersive X-ray spectroscopy).

Keywords
precision glass moulding
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